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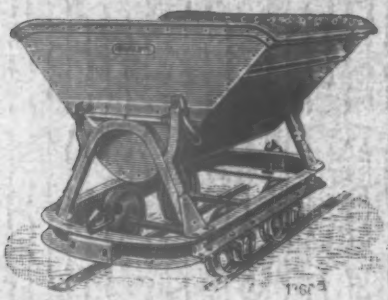

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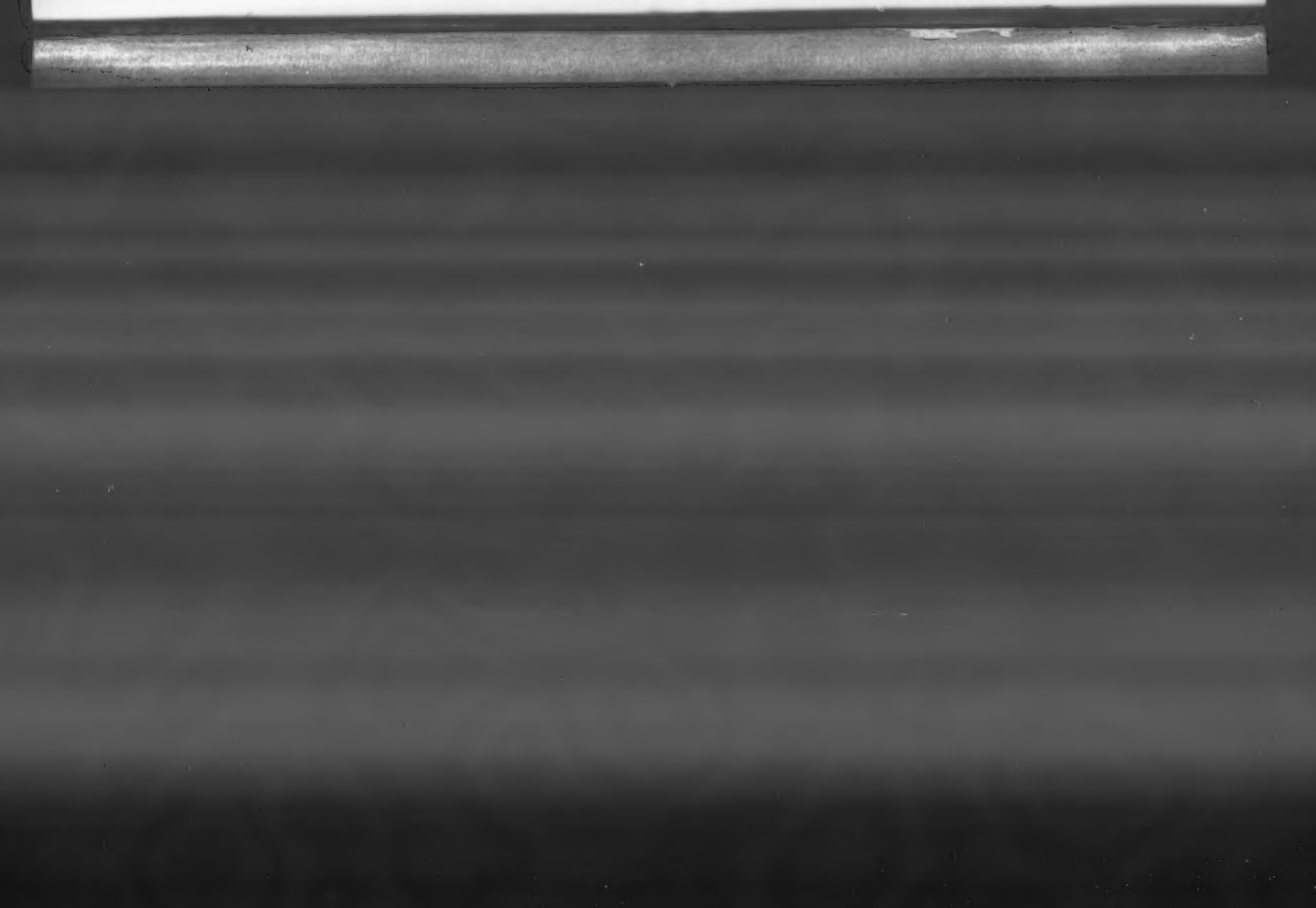

MUNICIPAL ENGINEERING

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THE BIRMINGHAM CONVENTION OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

THE COST OF CLEANING AND GRUBBING A RESERVOIR SITE.

By Julian Griggs, Consulting Engineer, Columbus, Ohio.

In this paper it will be the purpose of the writer to give with some detail the cost of clearing and grubbing the site of the reservoir formed by the construction of the Scioto river storage dam for the municipal water supply for the city of Columbus, Ohio.

The work to be described was but a small portion of the total expenditure of about $700,000 by the city for the dam and works appurtenant thereto, but the failure of the writer, after a somewhat extended search of engineering literature, to find descriptions of this portion of similar undertakings has led to the hope that a paper on the cost of clearing and grubbing a reservoir site will prove a welcome, though slight, contribution to the subject of water supply engineering.

Cases of complete soil removed, as in the Wachusett reservoir for the Boston Metropolitan Water System, are not unknown. Perhaps, however, it has never before covered so large an area and been done with quite the degree of thoroughness which there obtained, but wherever done it is for the engineer mainly a question of estimating the cost of excavating and hauling a given quantity of earth, while the clearing and grubbing become a secondary matter, as tending only to increase slightly the cost per cubic yard for excavating and removing the earth to a point outside of the reservoir.

In the Columbus case the usual conditions were reversed, for the reason that the Scioto river is normally a muddy western silt bearing stream, with a drainage area of 1,032 square miles above the dam and a flood discharge approximating a maximum of 50,000 cubic feet per second. The relation of reservoir capacity to maximum discharge is such that the reservoir at maximum flood flow would fill and empty twenty times in twenty-four hours. It is therefore expected that silt in material amounts will be deposited in the reservoir at every considerable rise of the river, and under these conditions it was not deemed necessary to remove any of the surface soil except to a very limited extent around former human habitations within the submerged area, but responsive to the requirements of the Ohio state board of health, all vegetable growths were cut down even with the ground, being then gathered into heaps and burned, while the stumps and roots of all trees and shrubs one inch or more in diameter were grubbed to a depth of one foot below the surface and similarly gathered and burned.

The reservoir is unique in its way by being unusually long, 5 8-10 miles, for its width, which varies between 200 and 820 feet, and averages only 504 feet at the water surface with reservoir full. The river in ancient times wore a gorge in the limestone rock of the Upper Helderberg formation, some ninety feet below the general level, for a width of from 600 to 800 feet ,and in more recent time has filled it in again with rich alluvial deposits to a depth of about 18 feet, through which the present stream, with a descent of five or six feet per mile, has cut its slightly meandering channel to twelve feet in depth and about 200 feet in width.

In places on either side of the gorge, vertical bluffs twenty to thirty feet high for perhaps a total length within the reservoir limits of two miles still remain, but generally speaking, the rocks forming the sides of the gorge have crumbled and now appear as steeply sloping hillsides, too rugged for cultivation and for the most part covered with trees and shrubs.

From the above description it will be seen that the reservoir formed by the dam, which has a height of 33 feet from its apron to its rollway, will fill the gorge at its lower or south end, 720 feet in width, and only the present river channel, 200 feet in width at its upper or

northern end. The greatest depth of water in the reservoir is 35 feet and the mean depth is 14 feet, or 40 per cent. of the maximum. The area of the river at ordinary low water within the reservoir was 125 7-10 acres, while the water surface of the reservoir at the elevation of the rollway is 351 acres.

A portion of the bottom land for an aggregate area of about 36 acres had been cultivated before it was purchased by the city, but the remainder was thickly covered with a growth of trees and shrubs common to the forests or groves of this locality, and consisted mainly of elm, oak, beech, hickory, maple, buckeye, locust and sycamore, the latter especially growing to large proportions, some of them being five feet in diameter. The shrubs were mostly osage orange, willow and pawpaw and smaller growths of the trees above mentioned. The bottom lands were very fertile, and everywhere, in addition to the trees, supported a rank growth of weeds; among which horse cane (Ambrosia trifida) predominated, growing to a height of 8 to 13 feet.

The area to be cleared and grubbed consisted then of two strips of land, one on each side of the river, together with a number of densely wooded islands, aggregating a total of 255 6-10 acres, 5 2-10 acres being below the site of the dam, cleared but not grubbed. The outside boundary of the clearing was contour 75 feet, which was two feet above the crest of the rollway of the dam.

The base of levels was city datum on an assumed plane 100 feet below the water table of the Ohio state capitol.

The dam, and the beginning or south end of the reservoir, is 7 1-2 miles northwest from the center of the city and is now reached by trolley cars with an hourly service.

Bids for the grubbing and clearing (Contract No. 3 improved water supply for Columbus, Ohio) were received by the board of public service on the 11th day of May, 1904, and varied from $70 to $155 per acre on an estimated area of 20 acres, as shown more specifically in the following table, the totals ranging from $18,900 to $41,850.

Name of Bidder.	Rate per Acre.	Total Bid.
Hoover & Kinnear....	$ 70.00	$18,900.00
John H. Clutter.....	149.50	40,365.00
Fisher & Knight.....	155.00	41,850.00

The proposal of Messrs Hoover & Kinnear, of Columbus, Ohio, was accepted and a contract with them was executed June 6. Work was begun on June 14, 1904, and carried on continuously until completed, April 5, 1905.

The method adopted by the contractors in doing their work was divided into three and at times into four operations.

First, a gang called the "Trimming Gang," consisting of from 4 to 20 laborers, equipped with axes and grubbing hoes, under the direction of a foreman, trimmed the limbs from the larger trees as high as they could reach, cut off the smaller trees about two feet above the ground, grubbed out the brush and roots and gathered into piles everything that could be burned.

Second, the trimming gang was followed by a "Pulling Gang," composed of from six to twelve laborers, a team of horses and a stump puller. Their work was to pull up the trees and stumps. Some of the time the same gang and at other times a third gang, (third operation) cut the trees and stumps into pieces that could be readily handled, grubbed out the exposed roots and piled the whole for burning, excepting such portion of trees as were saved for saw logs.

When the work began it was thought necessary to partly season and dry the brush and wood by several weeks exposure before burning, but during the winter it was found practicable to burn everything as soon as it was cut and piled.

The stump puller used was of the type known as the "Hawkeye Stump Puller," and consisted of a vertical iron windlass, operated by a team of horses. The bed to which the end of the spindle of the drum was secured, was formed of two pieces of oak timber each 10 inches by 10 inches by 16 feet in length, framed into a cross with equal arms. The drum was 13 inches in diameter and two feet in height. The spindle above the top of the drum was secured by four legs made of iron pipe, inclined outward at an angle of about 45 degrees. At the lower ends, the legs were tied together with an iron strap to prevent spreading, and each was fastened to an arm of the timber bed. To the end of the spindle projecting above the legs, was secured one end of an 8x8 inch oak timber; to the other end was hitched a pair of horses, making a sweep of 20 feet radius. Dragging from this sweep, directly back of the team, was a stiff stick, the end upon the ground shod with an iron point, the purpose being to hold the strain made by the sweep when the horses were standing or when taken away. With each machine there were two pieces of ⅞ inch wire cable about 100 feet in length, hooks, grips, blocks, snatch cables and so forth. Four of these machines were in use by the contractors.

In operation the timber bed was buried in the ground and to make it secure, iron pins were driven into the ground against

the sides of the timbers, or the timbers were loaded with stone. The snatch cable was usually fastened around the tree to be pulled from 10 to 20 feet above the ground. The cable was usually passed through a snatch block fastened to a tree near the stump puller so as to bring it into a horizontal position as it was wound upon the drum. If the tree was too firmly rooted to be moved when the strain was applied, sometimes a part of the roots were cut, but usually it was the practice to explode a charge of dynamite among the roots without releasing the strain from the stump puller. Stumps, of which there were large numbers, were harder to pull than the trees and most of them had to be broken up with dynamite and taken out in pieces. Many of the trees had roots at a considerable distance below the surface of the ground, probably due to the gradual accumulation of earth above them since the trees began to grow. Large quantities of dynamite were used. It is said that sixty sticks were exploded in removing one stump. After the trees had been pulled and burned the ground was all gone over during the months of March and April, all loose pieces of wood were picked up, any grubbing previously overlooked was done and the grass and weeds burned.

Item	Days	Rate	Total	Per cent of cost
Superintendent	255	$4.16 2-3	$ 1,062.50	2.6
Time Keepers	255	1.75	446.00	1.1
Foremmen	1030	2.50	3,325.00	8.2
Foremen	205	2.00	410.00	1.0
Carpenter	54	2.00	108.00	.3
Dynamite Men	435	1.75	761.25	1.9
Laborers	14491	1.50	21,736.50	53.3
Single Horse	222	1.50	333.00	.8
Two Horse Team	847	3.50	2,964.50	7.3
Dynamite	68,000 lbs	.11 1-2	7,820.00	19.1
Machinery and repairs	....	....	1,800.00	4.4
Total			$40,766.75	100.0

Cost per acre, $159.50.

The common harrow was found to be the best tool for breaking down and gathering the weeds. It is estimated that 3,000 saw logs were sold by the contractors at $2.50 per 1,000 feet board measure and there would have been many more if the trees had not been shattered by exploding dynamite.

The table of costs which follows is derived from the Inspector's daily reports, and is believed to be fairly accurate. It shows a total cost of $40,766.75. Common labor was paid $1.50 per day of ten hours and is the largest item of cost, being 53 3-10 per cent of the total. The next largest item is dynamite, 19 1-10 per cent, followed by foremen, 8 2-10 per cent, and horses 8 1-10 per cent, machinery 4 4-10 per cent, accounting for all but a remainder of 6 9-10 which is divided among superintendent, dynamite men, time keepers, blacksmith and carpenter. The cost per acre, therefore, for the work done was $159.50.

The final estimate given May 17, 1905, was for 255 6-10 acres at $70.00—$17,892.00.

In addition to the above there was paid to the contractors $1,685.10 for doing work outside of the contract, the following amounts being cost to contractors with 15 per cent added for use of tools and profits.

Building guard fences along public highways at dangerous places	$ 230.48
Removing trees and stumps from the river	283.75
Clearing the City's land above contour 75 feet	1,157.51
Miscellaneous work	13.36
Total	$1,685.10

The season was unusually favorable for the prosecution of the work as there were no delays and very little additional expense was incurred by reason of high water.

The foregoing table indicates that the contractors lost a comparatively large sum of money in the execution of their contract, but they never showed any disposition to slight the work or endeavored in any way to diminish to their advantage the amount thereof, neither did they permit the work to drag along, as not infrequently happens under such conditions, but prosecuted it with energy and completed the same within the time limits of their contract obligation, for which honest endeavor they are entitled to and should receive great credit.

Engineering. Prior to the beginning of the work by the contractors a line of levels was run on each side of the river and stakes set to indicate on the ground the position of contour 75 feet. These stakes were set as often as there was a change in the direction of the contour and were from 50 to 400 feet apart. As an aid to finding them again they were numbered consecutively from the dam. To check the work the two lines of levels were connected at intervals of about a mile.

After the land had been cleared, sur-

vey lines were run one on each side of the valley near contour 5 feet, and the contour stakes previously placed were located by right and left measurements. Survey lines were also run on each side of the river, from which the shore line of the stream was similarly located, and to check the work all of the survey lines were tied together at intervals of about a mile. Contour 73 feet was also run and a careful observation made to be sure that no grubbing had been omitted below that elevation. All survey lines were then platted and the areas having been computed by latitudes and departures were checked by planimeter measurement on the plats, which were made to a scale of one inch equal to one hundred feet.

Additional weed cutting and burning. In May, 1905, the site of the reservoir was practically cleared of all vegetation and ready to be filled, which by the requirement of Contract No. 1 for the dam was to have begun by the middle of that month. The work on Contract No. 1 had not been prosecuted at the rate stipulated in the specifications and was further delayed during the summer, so that by the middle of August the whole reservoir site was covered with a luxuriant growth of weeds, some of which measured thirteen feet in height, and it became necessary to remove them before the reservoir could be filled.

An unsuccessful effort had been made the previous season to burn the dead weeds as they stood upon the ground. Neither would they burn when broken down. The city therefore engaged a foreman with a gang of seven Italian laborers to cut the weeds and after they had sun dried, to gather into piles and burn them. This work began August 21, 1905, and was continued until water was running over the completed crest of the dam on the 6th of the following December.

Where possible a horse rake was used in gathering the weeds, but where the surface could not be raked, manure forks were used for this purpose.

Shortly prior to December 6 a day was fixed for dedicating the dam and it was then determined to fill the reservoir as speedily as possible. A large gang of extra men with tents and supplies were sent to the reservoir to rapidly complete the weed cutting and cleaning then being prosecuted by the city foreman and the small gang.

The cost to the city of the work so done between August 21 and December 6, 1905, was $1,969.00 divided into labor, tools and supplies as shown in table following:

Item	Labor	Tools & Supplies	Total
Small Gang.....	$1,210.13	$43.50	$1,253.63
Large Gang.....	428.78	286.66	715.44
Total.....	$1,638.91	$330.16	$1,969.07

It will be seen then for clearing and grubbing of a reservoir site under the conditions which obtained in the work herein described and neglecting the general expense of the contractors the cost with common labor at 15c per hour may be reckoned at $159.50 per acre, to which there may be added for extra work required a further cost of $6.73 per acre. And if the reservoir is allowed to grow up with weeds and needs to be again cleaned the added cost will be $7.86 per acre or a total for all work done of $174.09 per acre for the area covered, in which is included none of the cost of engineering and inspection.

For the very efficient supervision of the execution of this contract and the carefully prepared cost records and description as stated in the foregoing paper, I am indebted to Mr. F. B. Edwards, resident engineer in charge of the work under the direction of the writer as chief engineer of the board of public works of the City of Columbus, Ohio.

REPORT OF COMMITTEE ON WATER WORKS AND WATER SUPPLY.

Julian Griggs, Chairman, Columbus, Ohio.

In noting the signs of the times in the matters of water supply and waterworks your committee sees no diminution of the trend toward public as against private ownership of these utilities which has been so decided in recent years. Doubtless an array of statistics to show this trend by tables or by curves would be of some interest to the engineering profession, but the committee has gathered no such data; it has been contented with listing a few of the obvious tendencies of the present for the purpose of marking time, which is one of the functions of our convention.

During the year committees have been appointed from many of the state and local engineering societies and clubs of the middle west for action in common, looking to a prevention of stream pollution. Not much can be said as yet to have been accomplished, but as betterments are dependent on the growth of an approving public opinion, which is necessarily slow

in forming, the co-operation of many influential societies, as noted, is a distinct gain, which will tend to greatly hasten an improvement in the sanitary condition of our streams, a reform desirable from sentiments of cleanliness and decency, but also as a matter of public health, because with the rapid increase of population in our cities, surface waters from the rivers and streams must in the future be more and more utilized for municipal water supplies.

The general government is continuing important and useful work in the records of stream discharge and turbidity, to which have been added studies by specialists on the underground sources of supply in various sections. These underground sources are important, generally the cheapest in development, and most satisfactory for the smaller communities.

It will not be amiss to mention the large cities of America having plants for water filtration either in course of construction or recently completed. They are Louisville, Ky., Cincinnati and Columbus, Ohio, Pittsburg, Harrisburg and Philadelphia, Pa., Washington, D. C., and Providence, R. I. New Orleans may soon be included in the list. And there should be added some works by private water companies, such as the East Jersey, Hackensack and New Haven companies, with an aggregate normal daily capacity of sixty-eight million gallons, supplying the cities of Paterson, Passaic, West Hoboken and Millville, together with a number of smaller communities in northern New Jersey, and New Haven, Conn.

Very large sums of money have been and are being expended for the purification works listed, generally under adequate plans and with competent engineering direction. The number of cities to engage in similar undertakings in the near future is believed to be great, and the specialists now engaged in this line of work or in training for it are likely to have a busy time.

There is said to be but one municipal water softening plant in the United States, located at Oberlin, Ohio, a village of about 4,000 people, requiring 165,000 gallons of softened water per day, and only three such in the world. The largest is at Southampton, England, a city of some 70,000 population, with works of four million gallons daily capacity, in operation since 1888, and the other at Winnipeg, Manitoba, a three million gallon plant, which went into commission in 1901.

It is perhaps not surprising that municipalities have not been more progressive in softening their waters, for the reason that the sanitary cleanliness of a city water supply is of vastly more importance than the economic gains to be had from a soft water and our cities have been very slow to perceive and follow their duty, even with respect to the former.

It is surprising that our railway companies have only in recent years awakened to the advantages of a soft water for use in locomotive boilers, considering how they were daily forced to meet the losses due to hard, unsuitable waters, although the softening process had been known for half a century. The railway companies have, however, in recent years been calling into their service many young men from our universities who have been trained to think, and to this fact may be due, more than has heretofore been acknowledged, the improvement noted in railway practice.

An anecdote here will illustrate the point to be emphasized. It concerns a woolen factory said to have been located somewhere in Michigan. For years the proprietor used in washing his wool an extremely hard surface water, but presently for the comfort of his operatives developed an artesian supply, which proved cool, abundant and soft. He, however, continued to wash his wool with the hard surface water until some bright commercial traveler, in passing through the works, suggested the obvious change in method, which, when made, in a few months saved, in cost of soap required, enough to pay the whole expense of drilling the well and a considerable sum in addition. The commercial traveler afterwards, in relating his observation and experience, as above outlined, was asked by some listener how he accounted for the obtuseness of the manufacturer, to which he replied, "Oh, he was one of those western hustlers and didn't have time to think."

It may be noted as a promising sign of the times that in the management and operation of our waterworks the technical graduate is increasingly in evidence, that he has been trained to take time to think, and this sign is a harbinger of good for the future of municipal waterworks development.

YELLOW FEVER AND SANITATION.*

By J. N. Hazlehurst, City Engineer, Mobile, Ala.

After a history of the yellow fever epidemics in the United States and of the discovery of the yellow fever mosquito, Mr. Hazlehurst shows the effect of public improvements in preventing the spread of the disease in the following:

The first opportunity in the United States for testing the "mosquito theory" came during the summer of 1903, at Laredo, Texas, from infection traced to Tampico, Mexico. At the time, Laredo contained a population of some 18,000, residing on the Texas side of the Rio Grande river, and about 8,000 persons living in the Mexican section. Neither town possessed either storm or sanitary sewers, and their water supply was furnished by a chartered corporation from the turbid river, and was deficient both in quantity and quality, while the rates were such as to render its general use impossible to the poorer inhabitants and its character such as largely to forbid its consumption by others, hence the almost universal use of cisterns, casks and other receptacles, concerning which the Marine Hospital surgeon officially reported that "as a breeding place for mosquitoes and especially the *stegomyia fasciata*, it would be difficult to improve upon them." In the same report, he also stated that this species was found in enormous numbers and widely distributed.

Shortly after this outbreak, the Marine Hospital authorities assumed control, immediately inaugurating the then experimental work of fumigating buildings; screening cisterns and the oiling of pools, gutters and other likely breeding places of mosquitoes. According to an official report, "so thoroughly was the work of destroying mosquitoes and especially the work of oiling containers and other breeding places performed, that an officer of the Service detailed in Laredo to study infected yellow fever mosquitoes, could not find, after diligent search, enough *Stegomyia* in the adult, larval or pupal stages to carry on his work."

In Laredo, from September 1903 to March 1904, there had been upward of a thousand cases of yellow fever with about ten per cent. mortality, but for the first time in history, the disease had been conquered before a killing frost.

During the late epidemic in New Orleans, similar conditions largely existed, only a limited section of the city being provided with sub-drainage, while all portions of the city were without sanitary sewers. The distributing system of the water-works was entirely inadequate and the water supply, being unfiltered, carried in suspension ordinarily as much as four tons of sedimentary matter to each million gallons of water, resulting in the almost universal use of cisterns, casks and such containers, as may be inferred from Dr. White's report that at the commencement of the epidemic there were in use in the city of New Orleans sixty-eight thousand cisterns. Despite the headway gained by the fever there before the commencement of remedial action, and the adverse sanitary conditions, after 3,390 cases of yellow fever, resulting in 459 deaths, the disease was eradicated and all quarantine restrictions removed for more than a month prior to the first heavy frost. While the triumph of science was again complete, the costs of victory were heavy, several hundred thousand dollars having been expended during the campaign, while indirect losses could hardly be estimated.

From the record of the past two facts have been absolutely demonstrated.

First, that complete isolation and non-intercourse from and with the outside world, to be secured through unceasing vigilance, can prevent a first infection of any community without the tropics. Second, that after infection and even under the most unfavorable circumstances and conditions energetic remedial measures directed upon scientific principles as now understood will control and effectually stamp out any epidemic of yellow fever. While these facts are comforting assurances and mark a distinct advance, it is prevention rather than cure which should occupy the attention of those in authority, otherwise our cities, towns and villages, situate within the life-zone of this deadly peril, are forever doomed by fear of this introductory spark and through the instinct of self-preservation to maintain a costly and barbarous "shot-gun" patrol with the ever present possibility of accidental infection with all of its attendant hardships and misfortunes to stricken communities. Students of this subject can hardly fail to become impressed with certain facts in connection with the recurrence of yellow fever in the United States since its first entry; first, that while yellow fever formerly raged in

*Extracts from a paper before the American Society of Municipal Improvements.

many of our Northern sea-port towns, it has made no visitation north of the Mason and Dixon line for so many years that apprehension as to such epidemic in those sections of the country no longer exists. Second, that while formerly an epidemic in the South continued its spread into nearly every city until its course was checked by frost, since 1878 fewer cities were invaded and that certain cities, often far removed from each other, seemed to suffer under peculiar fatality in respect to its attack. Science must discover some reason for these facts.

An explanation given by Dr. J. H. White, of the Marine Hospital Service as to the disappearance of yellow fever from Northern cities is certainly entitled to respectful consideration and is as follows:

"It would be a false claim, if set up by any of our great northern cities, that, with municipal utilities which appealed strongly to their ideas of creature comfort and general cleanliness, and which incidentally and entirely accidentally eliminated the mosquito at the same time. These public utilities were a thoroughly controlled water supply, sewerage, drainage and pavements, and these four, not one, but all of them, were essential to the end attained."

Dr. White's contention is that although accomplished accidentally, the agencies directly responsible for the elimination of yellow fever were the introduction of these public utilities which prevented the propagation of the mosquito.

Let us consider the evidence in support of the fact that these same agencies may be relied upon to prevent the recurrence of yellow fever within the section now known to be the habitat of the insect responsible for the spread of this disease. Parenthetically it may be remarked that seldom does the construction of water-works, sewers and street pavement occur simultaneously, but generally in the following order. First, water-works are built; secondly, sewers are demanded to remove the waste water of the water supply, and lastly, after water and sewer pipes are laid, the streets are paved, the surface drainage being an incident of this latter construction.

After the epidemic in Memphis during the year 1878 when, according to Keating, some 17,600 cases of yellow fever occurred, resulting in 5,150 deaths, and the return of this disease the year following, Col. George E. Waring, C. E., was retained to design and construct a system of sanitary sewers, the first comprehensive application of the separate system upon this continent. Concerning the potentiality of these sewers in the prevention of another disaster from like cause, Col. Waring made the following remarkable prophecy in his address before the Am. Public Health Association, at Nashville, Tenn., November, 1879:

"I trust that, as I am neither a Southerner nor a physician, I may be excused for attaching more importance than many of you probably do to the proper drainage and cleaning of a city, and to the proper disposal of its outflow, and more than to any system of quarantine. My knowledge of the history of the yellow fever epidemics in this valley is infinitely less than yours, but I feel warranted, and I take my warrant from the history of the plagues which devastated the filthy mediaeval cities of Europe, and from my own knowledge of the want of cleanliness and want of drainage in the city of Memphis, in venturing the suggestion that even that fever-smitten town may be made an impossible field for the invasion of yellow fever in epidemic form."

While Col. Waring's theories probably had few converts, the necessity of doing something towards securing relief from this scourge drove the people of Memphis to commence its sewer system which now comprises 210 miles of sanitary and 4 miles of storm sewers.

Since the first work was inaugurated, Memphis, although frequently menaced, escaped any attack of yellow fever until the year 1897, when the plague being general throughout the Mississippi valley, 50 cases and 15 deaths was accredited to Memphis.

From a population of 33,592, according to the census of 1880, that city had grown to 102,320 inhabitants in 1900. From a recent letter from the City Enthere in 1897, the following is quoted:

"Regarding fever conditions here in '97, beg to say I have investigated the matter and find that we had 50 cases and 15 deaths. All of these cases were distinctly traceable to one locality except one which was shown to be imported from New Orleans. The infected district was unsewered. It was inhabited principally by people of the lower class. It was partly paved and had water-connections."

Before the year 1880, no city in the South had more than a most fragmentary system of sewers, but after the example set by Memphis, the larger towns one by one inaugurated more or less extensive and comprehensive systems of sewers, until of the principal cities there remain unsewered only New Orleans, Vicksburg, Pensacola and Galveston.

Systematic effort has been made by the writer to secure statistical information as to paving, sewerage, water-supply and like municipal improvements of all the

cities located within the fever-zone and as well, the dates since 1878 showing recurrence of yellow fever in each.

Reports from more than twenty such cities show that, exclusive of Memphis, whose experience has been recited at length, only four towns have been afflicted with yellow fever since the construction of systems of sanitary sewers. These towns are Montgomery, Ala., Natchez, Miss., Baton Rouge and Alexandria, La.

The most important of these towns is Montgomery, whose sewers were construted in 1889, and despite which, suffered from fever in 1897, 134 cases being reported during that year. At the time these sewers were constructed, the city had a population of only about 20,000, and this had expanded to more than 30,000 at the time when the epidemic occurred. It is also reported that the fever at that time existed only in sections of the city which were unsewered and that no case was recorded within the sewered districts, indicative of the fact that the city had outgrown its first sewerage works.

Natchez, Miss., during the past year, suffered by yellow fever to the extent of 143 cases and 7 deaths. This city has 45 miles of unpaved streets; 7 miles of sanitary sewers and 2 miles of storm sewers. According to official report, only two cases of yellow fever occurred in dwellings provided with sewer connections. It is also reported that connection to sewers is not compulsory, and few such have been made. The sewers were constructed and owned by a franchise corporation supplying the city with water. Numerous cisterns are in use owing to a deficient water distribution and supply.

Baton Rouge, which also reported 10 cases of fever and 1 death during the past epidemic of fever has also a deficient water system, owned by a private corporation, and relies also largely upon cisterns and like water containers. In 1901, 7 miles of sanitary sewers were constructed by the city, but only 150 connections have been made volutarily.

Lastly, the town of Alexandria, La., built its 9 miles of sanitary sewers during the year 1900, and in this town, connections are compulsory. During 1905, nineteen cases of fever were returned, with one death. Concerning conditions there during the fever continuance, the city engineer writes as follows:

"While city water is generally used, a considerable number of the population have tanks, cisterns and barrels for gathering rain-water. * * * * The spread of the fever in this place seems to have been due entirely to the quite extensive use of cisterns which were not screened, and so formed breeding places for the mosquito."

Alexandria is built upon ground extremely low and flat, and open canals and ditches are relied upon to remove the storm-waters. It is especially worthy of note that during the epidemic of 1905, New Orleans, Vicksburg and Pensacola were the principal sufferers, cities deficient in sewers of all descriptions, and in contrast, during the same year refugee or imported cases of fever occurred in Montgomery, Ala., Tampa, Florida, and Shreveport, La., cities which in the past, from such infection would undoubtedly have been quick to respond, but no spread of the dread disease occurred. It is significant that these three cities have been effectually sewered and connections are made compulsory. If such statistical facts are considered merely coincidences, in further support of the theory that sanitary sewers, especially when augmented with an abundant and suitable water supply may be relied upon to prevent the spread of yellow fever, the cases of Vera Cruz, Merida, Yucatan, and the City of Havana may be cited. The first of these cities was sewered and paved about three years since, and although for generations, each year witnessed an outbreak of yellow fever, whose virulence was limited only by the extent of the immune population, few cases and no epidemic of yellow fever has since been reported. The city of Merida, following the example of Vera Cruz, has lately expended something more than four millions of dollars upon her public utilities. This city of the tropics, accustomed each year to reckon the victims of yellow fever by the hundreds, reports only 10 cases of fever for the fiscal period, accounted for by a recent press dispatch as follows:

"This great improvement is due to the improved system of isolation and the institution of modern sanitation."

But that isolation alone may be expected to fail in providing adequate protection may be well suspected from the late experience in Havana, a city where this method of protection may be admitted to have reached its highest development. Infected from the epidemic of 1905 at New Orleans, and despite the most active efforts of its health officers, yellow fever made marked progress there, and resulted in the establishment of quarantine restrictions against that city upon the part of North and South American sea-ports. Havana has no system of sewers.

In view of the evidence submitted, the deduction seems warranted by the facts that even a city in the tropics may be freed entirely of yellow fever by providing

modern municipal utilities, and the potentiality of these agents must be far greater when applied to communities where yellow fever is known to be exotic, hence the writer feels fully justified in the assertion made by him at the close of the campaign inaugurated by the Mobile Auxiliary Sanitary Association, as follows:

"What has been written is not intended to belittle or detract from the intelligent effort of our local health board in its successful maintenance of scientifically formulated quarantine regulations, nor to underestimate the work accomplished by this association, but that the fever has not fastened upon our city, seriously menaced though it were, is probably neither a miracle, due to a special dispensation of Providence, nor to the preventive and remedial measures exercised during the present crisis. While each has done what he could, with the previous installation of a bountiful water-supply and the construction of a comprehensive system of sewers, followed by the completion of a considerable area of street paving, exercising reasonable prudence and precaution, no longer need Mobile tremble at the outbreak of fever in this section, for danger from this source has passed for all time."

SANITARY CONDITIONS IN NEW ORLEANS.*

By George G. Earl, General Superintendent Sewerage and Water Works.

New Orleans was founded in 1718, and under French government until 1769, from which date, until 1803, she was under Spanish control. In 1803, after the Louisiana Purchase, she passed into the hands of the United States, with a population largely of mixed French and Spanish origin.

Located at the ocean gateway of one of the greatest systems of navigable waterways in the world, when heavy transportation was compelled to move almost entirely by water, New Orleans became at once a city of destiny, and, despite natural obstacles, she was in 1800 the fifth city in the United States in population.

From 1800 to 1830 the rate of growth of New Orleans paralleled the growth of Boston, Baltimore and Philadelphia, reaching a population of 46,000, despite an average death rate of over 42 per 1,000, brought about by unsanitary conditions, and particularly by frequent visitations of yellow fever, introduced through commercial intercourse with tropical countries to the south.

From 1830 to 1840 New Orleans more than doubled her population, passing the 100,000 mark and reaching the position of the fourth city of the United States in population; only New York, Philadelphia and Baltimore had a greater population, and the two last named were but a few thousand in advance. This growth in population came notwithstanding an average annual death rate of nearly 60 per 1,000. During the decade severe yellow fever epidemics were of frequent recurrence, and for two years cholera raged with a death rate in the worst year which removed nearly one-sixth of the total population.

That the city doubled in population under these conditions speaks volumes for the logic of her location.

After 1840 the logic of location gave way to the more inexorable logic of death, and the growth of New Orleans, as compared with other cities, showed favorably only in the cemeteries. From 1840 to 1860 the death rate averaged about 58 per 1,000 of population—far more than double tnat of other cities.

The war brought an embargo on commerce from Southern ports, and a general cleaning up, with some crude efforts toward drainage, which reduced the death rate for the decade 1860 to 1870 to about 40 per 1,000, despite a terrible yellow fever epidemic, which followed the renewal of commerce in 1867.

In 1873, and again in 1878, frightful epidemics of yellow fever were experienced, but the average death rate for the decade was cut down to something like 32 per 1,000.

After the experience of 1878, the State Board of Health was re-organized and an efficient quarantine was established at the mouth of the river, which prevented the introduction of yellow fever in the decade 1880 to 1890, and the death rate was reduced to an average of 28.5 per 1,000.

From 1890 to 1900, conditions affecting the health of the city remained substantially as in preceding decade, except that yellow fever found entrance through another gulf port and reached New Orleans by infection brought from this point in 1897, and was present in the city in decreasing amounts in 1897, 1898 and 1899. These visitations of fever were not severe

*From a paper before the American Society of Municipal Improvements.

and had comparatively small effect upon the death rate, which averaged about 27 for the decade, standing at that figure for the last two years thereof.

In 1900 New Orleans had a population of 287,000 and stood the thirteenth city of the country in population. Her decline from fourth place, which she occupied in 1840, may be charged partly to the fact that railroads leading east destroyed the power of inland water transportation to command commerce, and partly to the retarding influence of the war and of the era of so-called re-construction, when incompetent and corrupt rule plunged the city and state into a sea of debt, from which they are only now beginning to emerge. But the sanitary condition of the city, and the evil sanitary reputation which lingered even as the conditions began to improve, has been the chief cause of her failure to grow from within and to attract growth from without.

If some power could have reduced the death rate of New Orleans to 20 per 1,000 in 1867, and maintained it at that rate, there is little doubt but that she would have had a population of over 500,000 people in 1900.

The main cause which prevented sanitary improvements on an adequate scale was a conservatism which pointed to natural difficulties that were claimed to be insurmountable. A large element of the population really took pride in saying that the city could not be sewered or drained and that the waters of the Mississippi river could not be purified on a scale adequate for a public water supply. The result of this conservatism was that nothing was undertaken.

It is true that the conditions in every respect were most difficult. New Orleans is practically in the center of an alluvial plain, which has been built up by the deposit of the silt laden waters of the Mississippi river, which river has, in recent geological times, advanced a coast line 100 miles long an average of about 80 miles into the gulf from the original gulf coast. This great alluvial plain lies at just about mean tide level and is intersected by old river outlets, along each side of which a narrow strip of land has been raised by the heavier deposit from overflows to a few feet above tide level, sloping gradually back to tide level swamps, lakes and bayous in the rear. Through accretions of fine silt, and through the growth and decay of vegetation, with a gradual subsidence of the accumulated mass, a new land was being slowly created by the forces of Nature. Its fertility was a temptation not to be resisted, however, and very early in the history of the country every available elevation capable of cultivation was taken possession of. Gradually levees were constructed to prevent further overflow from the river, and thereby Nature's process of gradual filling has been arrested.

New Orleans was located solely with a view of taking every possible advantage of the opportunities for navigation which existed, and from this standpoint the location could not have been better chosen.

The city itself, or that part of it which is receiving any consideration in present development, covers an area of about 33 square miles and could easily accommodate a population of 1,500,000 people. This area is bounded on the north by Lake Pontchartrain, on the south by the Mississippi river, and on the east and west by levees. (Incidentally it should be said that there are levees between the city and its north and south boundaries also).

The Mississippi river is about one-half mile wide and from 90 to 180 feet deep at New Orleans. At low stages of its water the river surface rises and falls with the gulf tide, and despite the fact that its minimum discharge is 200,000 cubic feet per second, and its distance from the gulf 100 miles, we often find its surface at New Orleans practically at gulf level. At high water the river surface is nearly 20 feet above gulf level, and its discharge something like 2,000,000 cubic feet per second, and every foot of natural ground in the city, except the levee tops, is from 6 to 20 feet below the surface level of its seething yellow waters.

Lake Pontchartrain, the northern boundary of the city, is really a shallow arm of the Gulf of Mexico, slightly brackish and effected by gulf tides, which have a daily fluctuation of only a few inches, but which depend upon the influence of the winds and have an extreme range of over 6 feet, from more than 4 feet above to nearly 2 feet below mean gulf level. The 33 square miles of area of the city, with reference to mean lake levels, lie as follows: 17 square miles at from 2 feet below lake level to lake level; 7 square miles at an elevation between high and mean lake levels; and 9 square miles from high lake level to 10 feet above said level, but still from 5 to 14 feet below the level of high water in the Mississippi river.

The natural soil is practically all an alluvial deposit or a product of such deposit in vegetation more or less decayed. Irregular strata of sand from fine to coarse, and clay from very soft to reasonably firm and mixtures thereof, roots and peaty strata with cypress stumps and logs

from forests of other days, some decayed and some very well preserved, all go to make up a soil condition which for underground constructions or for foundations presents an average of cost and difficulty not often encountered.

The bearing of the above outlined conditions upon needed sanitary improvements at New Orleans, especially upon sewerage, water works and drainage, is obvious, particularly as one board is charged with the three works, with a common fund, so that the development of either is necessarily to a degree dependent upon the other two.

In 1892 when the writer first located in New Orleans the city had no sewerage system and no underground or deep drainage, the then existing drainage being only a matter of surface gutters leading into open canals, in which the water always stood within two or three feet of the ground level, which were overflowed for hours and, in parts, sometimes for days after every considerable rain.

Of the 60,000 premises then existing each had a hole in the ground to receive fecal matter; each discharged its liquid wastes into the open street gutters, and each depended for its clear water supply, and usually for its whole water supply, upon cisterns, i. e., cypress tanks built above ground and precariously supplied with rain water from the roof of the premises served. About one-tenth of these 60,000 premises had also a connection with the mains of the New Orleans Water Works Company, which only covered about 100 out of 350 miles of built up streets and supplied Mississippi river water (and mud) to its consumers. This water, filtered through stone filters, was and is magnificent water, but in its natural state, as drawn from the mains, is really unfit for practically any use.

A description of the new water works system is given, which will appear in a later number of MUNICIPAL ENGINEERING, and the paper concludes with the following statement of the new conditions some of which are now in existence and others soon will be:

The general effect which the works now in progress must have upon the health and comfort of New Orleans are well illustrated by the following facts:

The drainage system, adequate to handle ordinary storms as they fall and to keep the ordinary level of the water in the drainage canals down to from 10 to 15 feet below the ground level, went into operation in 1900, and immediately thereafter the death rate fell from 27 per 1,000 to 21.5 per 1,000, and has subsequently remained substantially at that figure, while thousands of acres which were formerly marshes are now dry and being built upon and improved.

Where sewers are being constructed in every street and kept pumped out the seepage or ground water flow collected into them amounts to over 1,000,000 gallons per square mile of area drained per day, and the effect of this under-drainage is very marked in the reduction of the saturation of the soil, and of the normal flow in street gutters. When the sewers are fully connected the dry weather flow in the street gutters will be practically eliminated, and the vaults and cess pools now existing all over the city will be a thing of the past.

With waterworks in operation, the cisterns at every house, and existing muddy water supply, can be done away with and a pure water supply, under an adequate pressure, substituted.

All of these things will make for the health of the community, and there seems to be a fair prospect that the existing death rate of 21.5 per 1,000, which compares well with other large cities, can be still further decreased.

With cisterns, gutters and marshes furnishing breeding grounds for the various types of mosquitoes which each propagates, the eradication of the types of mosquitoes which are known to spread either yellow or malarial fever, when such fever is well introduced, has been a very difficult task, yet yellow fever, very strongly started last year, was stopped by systematic oiling and screening of cisterns and oiling and salting of other standing waters.

The magnitude of such a mosquito campaign over an area of 33 square miles, with 800 miles of street gutters and 65,000 cisterns, many of them two or three story affairs, is obvious, and with our present knowledge of the advantages to be derived by the practical extinction of the Stegomyia and Anopheles mosquito, and the comfort at least arising from the removal of other types, the construction of sewerage, water and drainage systems in New Orleans would be warranted if this alone could be accomplished.

That these systems will be effective in this direction as well as in a general sanitary improvement, is beyond any doubt, and it can be confidently predicted that the New Orleans of the next decade will deserve and have a sanitary reputation which will enable her not only to retain her present prosperity but to increase her rate of development in proportion to the magnificent opportunities which lie before her.

REPORT OF COMMITTEE ON STREET PAVING.

James Owen, Chairman, Newark, N. J.

Paving and maintaining the streets and roads of cities and densely populated counties is a difficult and expensive portion of public work. Ultimate economy means good first construction and prompt repairs, instead of neglect and relying only on what is termed the "life of a pavement."

The past tendency to depend for good pavements on bond or guarantees is beginning to cease. The responsibility for good construction and maintenance is being gradually placed upon city engineers. Where a city depends upon a guarantee or bond, this means to transfer the responsibility from the engineer to the legal department of the city. Lawyers do not inspect a pavement and compel a contractor to keep it in good order. They wait till a pavement has become useless, as, for example, with poor brick and certain kinds of asphalt pavements injured by weather and light traffic, and, then try to collect cash damages. The people would prefer to have a pavement on the street rather than a bond or cash damages. Your Committee recommends that pavement guarantees be gradually abolished and that city engineers shall be made responsible to secure the best pavements of various kinds called for on different streets and roads. Architects are held responsible for the construction of public buildings. They do not depend upon guarantees for proper construction. City engineers see to it that sewers and water works are constructed correctly. Such works do not depend upon bondsmen for lasting qualities. It is not the fault of the engineers, but generally of the legislative branches that guarantees and bonds have displaced true inspection. Under the present political conditions, however, no engineer who insists and shows himself competent in preparing specifications and looking after pavement construction and repairs, is interfered with by aldermen or members of boards of works.

In our cities during the past year, the tendency has been to continue to get rid of old cobble and rough stone pavements, and to lay pavements with smooth or even surfaces. The use of durable foundations is steadily extending, for the general reason that the wearing surfaces of pavements whether of blocks or various kinds, asphalt, bitulithic or other material, can thus be economically and better maintained in constant order.

In the suburbs of cities and in densely populated counties, earth, gravel and poorly constructed roads are steadily being replaced by properly constructed macadam and telford. In some places these are being treated with dust reducing compounds of various kinds. These compounds are often patented or proprietary and in experimental stages. Great progress, however, is being made not only in the materials used but especially in the methods of application. The destruction of macadam surfaces by weather and traffic augmented largely by automobiles, makes the problems of durability and suppressing dust more important than ever. The roads are being placed in the hands of experienced engineers to secure more economic and efficient construction and maintenance, not possible under old methods of superintendence.

The principal kinds of pavements which have been laid during the past year are as follows:

In large cities, a decreasing amount of asphalt for new construction; a decreasing amount of granite block, but where laid the blocks are better laid than ever, and almost always on concrete foundations; an increase of the bitulithic pavement in many cities; an increase of treated wood block pavements on concrete foundation in a few cities; a small increase of brick pavement, much being with better bricks with joints filled with cement grout and laid on concrete foundations.

In medium sized cities; very little granite and other stone block pavements have been laid, but more of it on concrete foundation than formerly; large amounts of the bitulithic pavement; a little treated wood block pavement on concrete foundation; a slightly increased amount of shale or better class of brick and a decreased amount of fire-clay or poor class of brick pavements; comparatively little asphalt pavement, except for resurfacing old asphalt pavements; macadam with and without telford foundation to some extent in cities on outlying streets and avenues.

In small cities; almost no asphalt pavement has been laid in the past year except in a few cities for the first time; a very little treated wood block on concrete

foundation in a few cities; a slightly increased amount of miscellaneous brick pavements in cities of the middle west; an increasing amount of bitulithic pavement in cities previously using it, and in cities not having previously used it; macadam has been extensively laid as usual in small cities.

In suburbs and well populated counties; The general trend is for an increasing demand for perfect surfaces whether in broken stone or gravel road and also to the elimination of the dust problem due to the enormous increase of travel by automobiles. The dust problem can only be solved in an economical way by experiment and investigation of the use of extraneous materials, such as crude oils or tar.

As to quantities of pavements in the United States, certain pavements have steadily increased and warrant a brief review.

Asphalt pavements of various kinds and qualities are still being laid, but with a very small rate of increase. It had its rapid increase during the eighties and nineties due to a demand for a comparatively quiet and sanitary pavement (that being then the only available one). The asphalt industry is now somewhat broken up. There are several sources of supply and several companies and contractors laying these pavements. The result is cheaper and poorer work. Cities, with few exceptions, are not equipped to know during the construction of asphalt pavements just what they are getting, good or bad. Excessive repairs and resurfacing of asphalt pavements, especially of those which decay, now fall on cities, guarantees or periods of free repairs having elapsed. Many cities therefore hesitate to lay more asphalt pavements, at least until they can be sure from inspection of their own engineers or by special experts employed, whether they are getting good asphalt pavements.

Wood pavements some years ago were used in several cities and poorly laid. Such pavements were but temporary street coverings, and practically all disappeared. Many western cities, never having had experience of the great Nicholson wood-pavement fiascos, which put Washington City several million dollars in debt, to be paid long after the blocks had disappeared, and which bankrupted Elizabeth, N. J., and embarrassed several other eastern cities, seem to have forgotten the wood-block pavement craze of thirty years ago and are again having wood-blocks offered to them. Many cities, however, have investigated wood pavements, with the result they demand concrete foundations and blocks treated by creosote or other equally good method to keep them from decay. Twenty cities have laid in the past seven years, very small amounts of such wood pavements as experiments. About thirty other cities have laid during the past six years amounts varying from 1,000 square yards to about 350,000 in New York City. The increase of treated wood-block pavement on concrete foundations is principally in large cities which can afford this pavement. It is used on streets of noisy traffic to suppress the noise. Because of the lack of experience of the true cost of maintaining wood pavements cities eventually using them may have to pay much greater prices than at present. About 30,000 square yards of treated wood on concrete was used in the United States in 1900. The average increase since then has been about 160,000 square yards annually. There are now about 1,000,000 square yards of these wood pavements in a little more than 50 cities of the United States, equal to about 57 miles of 30 foot roadway.

The bitulithic pavement is a modern pavement of specific kind, laid under certain patented processes, methods and mixtures. Without describing this pavement, more than to say that the wearing surface consists principally of crushed stone mixed in predetermined proportions and having a minimum amount of voids, and the whole mass cemented together with special bituminous cement which also fills the voids, it is sufficient to report that this kind of pavement began to be laid in 1901, in eight cities to an extent of about 20,000 square yards. Its increase since then has been an average of about 1,135,600 square yards annually. It is now laid and being laid in about 131 cities with an aggregate of about 5,698,000 square yards or about 323 miles of roadway thirty feet wide. This pavement is worth attention because used by so many municipalities. It seems practically noiseless, little affected by weather and not as slippery as other kinds of monolithic pavements.

Brick pavements for many years were their own worst enemies, because of weak bricks and poor construction. During the past few years strong efforts have been made by some cities and by several makers to increase the requirements of the specifications and tests of paving bricks, so as to secure pavements better able to resist the action of weather and traffic. A reasonable degree of success is attained in some cities especially where complete

specifications, containing fully defined, technical tests, followed by a thorough inspection during construction, are the rule of procedure.

Macadam and telford pavements during the past year have been laid and repaired with more care than ever on certain streets and in the suburbs of cities. The demand and need for them is greater as the suburban population increases.

THE MUNICIPAL ASPHALT PLANT AT HAMILTON, ONT.

By E. G. Barrow, City Engineer.

Our municipal asphalt plant has, to my mind, demonstrated the necessity of every city owning its own plant. Repairs are made with less expense, no delay occurs as happens when dealing with a contractor, and an intimate and exact knowledge is obtained of the quality of the materials and the proportion and temperature at which they are mixed and prepared for use on the streets.

The two principal streets of our city were laid with Trinidad asphalt by the Kramer-Irwin Company some twelve years ago. The annual repairs, especially during the latter part of the ten-year guarantee period, became very numerous and at the expiration of that time were done by contract at a cost of $1.35 per square yard. The board of works, owing to the excessive cost of the repairs and also the tardiness of the contractor to do the work, decided to purchase the plant from the Kramer-Irwin Co., who did the oiginal work, at a cost of $8,500. This plant consisted of four ordinary steel shell driers revolving on a shaft passing through them. The sand was delivered to drums by conveyors at the front, and after passing through them was discharged into a pit and elevated to a platform. The material from the four drums was then mixed and loaded into a bucket by hand and conveyed to the mixer by a trolley. There two melting kettles of a capacity of about six tons each, a mixer, air compressor, engine and boiler, oil pump and two oil tanks of about 4,000 gallons capacity.

The street tools consisted of a 5-ton steam road roller, fire wagon and surface roller, with tampers, rakes and other small tools.

On account of the unsatisfactory service afforded by the mixer, drums and drum shafts, the latter continually breaking, the mixer leaking, and the crude way of handling the dry sand, these four drums were discarded and a modern Hetherington & Berner single drum sand drier was installed with a mixer, and sand storage bin with a capacity of 8 cubic yards, having attached at the bottom a measuring box, capacity 8 cubic feet. The cost of adding new sand drier, sand bin, measuring box and mixer was about $3,000.

The sand drier is a single drum 42 inches in diameter, 14 feet long, and is provided with exhaust fan for creating draught. The housing for drum is steel and the drum is carried on two bearings, a trunnion on front end and ring bearing on back and riding on rollers which revolve on eccentric pins to allow for taking up any wear. The heat passes around the outside of the drum to the front and then through the drum, where it comes in contact with the sand passing through. The sand is conveyed to the drums by elevator buckets and after passing through drum is conveyed to storage bin by an upright continuous elevator. At the front end of the drier there is an opening to get samples of sand to test the temperature. Before passing into storage bin the sand passes through a revolving screen of No. 10 mesh when running surface mixture. In running binder a slide door is opened, which allows the stone to go into the bin before it reaches the screen. The material passes from storage bin to measuring box and from there to the mixer and then to the wagons, which can drive under the mixer platform. The material is not touched by hand from the time it goes into the drier until it reaches the street. We are having a closed kettle made of 7 tons capacity with a mechanical agitator in it, and when installed will do the melting down in the open kettle and then transfer the material over to the closed kettle for agitation and delivery to the mixer by compressed air, thus doing away with one man now employed dipping out of the open kettle into the asphalt bucket, which is on a trolley running over the kettle.

The plant, with its additions, and improvements, consists of a Corliss engine of 45 h. p., with boiler of same capacity, sand drier, two open kettles of 6 tons capacity each. In addition we will have one closed kettle agitator of 7 tons capacity, oil pump, two oil tanks of 4,000

gallons capacity, air compressor and barrel elevator for hoisting material. The capacity of plant is about 1,000 square yards of 2-inch surface mixture per day. The number of men required to run the plant is fifteen, including foreman and all men employed about the plant day and night.

On account of the original grading not being up to the standard, the average thickness of asphalt laid in Hamilton this year is over 2 inches. Since May we have turned out of the plant 3,141 cubic yards of surface mixture and 502 cubic yards of binder. In resurfacing the concrete has been treated to a coat of paint, consisting of California asphalt fluxed to a proper consistency.

This binds the surface mixture to the concrete and prevents the water getting between the two materials, also prevents the surface mixture creeping. On all new work we are using a course of binder next to concrete of about one inch thickness and a course of surface mixture two inches thick, at a cost of ninety cents a square yard for mixing and laying. This includes taking up old asphalt and disposing of it.

The asphalt is California D grade with a mixture of Cuban, for we find that a mixture of hard asphalt, such as Cuban, adds toughness to the California.

In order to make the asphalt cement mixture suitable for the different conditions of streets as to sunlight, traffic, etc., a Dow penetrating machine is used.

The sand is tested at the plant by a set of screens ranging from No. 10 to 200 mesh, in order to get a proper mixture and reduce the voids as far as possible and make a good compact mixture. On the grading shown in the sand as taken out of the measuring box over the mixer depends the amount of lime stone dust required to make the mixture of the proper grading to carry the required amount of asphalt cement for the service for which it is required. After the sand, stone dust and asphalt cement have been thoroughly mixed and dumped into the wagon, it is tested by what is called the stain test, in which a small amount of the mixture at the proper degree of heat is put between a folded paper and this placed between two boards which are compressed to make an impression on the paper, and the density of this stain shows the amount of asphalt the minerals are carrying, which we find should be as high as possible in order to stand the great amount of moisture to which our pavements are subjected by continual sprinkling.

THE PAVEMENTS OF KANSAS CITY, MO.

By E. A. Harper, City Engineer.

All our paving in Kansas City is more or less in an experimental stage. We tried the cedar blocks and abandoned them some fifteen years ago. After that came a period in which all paving was asphalt. This asphalt was constructed through promotion by the Barber Asphalt Paving Company, they having agents on the street who worked on commission, the ordinance specifying their particular brand of asphalt, it being the policy of the city to depend upon the ten year guarantee made by the paving company for the good quality of the asphalt surface rather than upon the inspection by the department. The first pavements laid by this company, during the period when they were building up their reputation, were very satisfactory, but of late years since they have gone into the trust their work does not seem to be as well constructed. Within the last year and a half the board of public works has adopted a method of open specifications in which they cut out the promotion through petition specifying a particular brand, throwing all the paving companies on an equality and getting competitive bidding and considerably lower prices for work.

This necessitates an inspection and analysis of the materials used by these various companies. We are trying to get the department organized to look after this branch of the work, but through the red tape and complications of a political department we have not gotten this into satisfactory shape and hope before another year is out to have this department so organized that we can give a satisfactory report on our asphalt pavements.

The only other pavement that we are trying is the bitulithic pavement, but we have no street laid with this pavement for more than six months, therefore nothing that I could say would be of any value.

The park board has tried the creosoted wooden block on a portion of one of the boulevards. We have also laid it as a

flooring on one of our bridges. This pavement has only been laid a few months and probably by the end of another year we will have some data on this class of pavement that will be of value. We are using the tamarack blocks with sixteen pounds of creosote oil treatment. The boulevard was laid without tar filler, the joints being filled with sand. The first heavy rain after the pavement was laid caused these blocks to swell and in one or two places threw them out of the street grade. This was repaired and we have had no trouble with this pavement since. This was a 60-foot width street with an inch expansion joint on each side. This was probably enough expansion to take care of any variation due to heat, but was not near enough to take care of expansion due to swelling of the blocks. The creosoted blocks used on the flooring of the bridge were well covered with coal tar, filling the joints, and a heavy coating of sand was spread over the top while still hot. This was on a 4.7 per cent grade, but we have had no complaint from the teamsters using this viaduct. All we have heard from seem to be very much pleased with this style of pavement, even with a grade as steep as this.

We have a little Colorado sandstone and some vitrified brick. The vitrified brick used up to the present year has been very unsatisfactory, the various companies promoting their special brick, guaranteeing it for seven years. Within the last year and a half we have incorporated in our specifications the test adopted by the National Brick Manufacturers Association requiring that all brick used be tested in a standard rattler, our requirements allowing a 20 per cent loss during 1,800 revolutions. Since that time our bricks have improved in quality.

AN EXPERIENCE IN OILING A CITY STREET.

By Frank H. Wright, City Engineer, Helena, Ark.

The writer does not care to pose as an expert on the use of oil for road purposes, for he is none such, but being anxious to contribute something to the success of the Birmimngham meeting, he has assembled a few facts gained from an experience of his own during the past summer.

The street had had some work done on part of it the preceding spring. There were two blocks, about 700 feet in all, the upper block having good crown on about a six per cent grade, and the lower block a much flatter crown, dropping off from the upper block on about an eight per cent grade to about one-half way down, then about a four per cent. There was a total rise of about forty feet in the two blocks, and in heavy rain storms there had always been very much washing of the gutters and in the wagon tracks on the crown, as the soil was a very soluble yellow clay, Helena being the termination of Crowley's Ridge, which is well known to engineers and geologists of the Mississippi Valley.

The street was thoroughly plowed twice for a width of forty feet, the amount used for traffic, the plow being a small pointed Avery with a steel beam. After plowing, a disc harrow was thoroughly applied, after which a toothed harrow was used until the whole street was like ashes. One team only was used on this preliminary work with a driver, but a shaker was used with the plow. The plowing and harrowing consumed about two days time.

To get the oil from the car a small lever pump was bolted to the floor timber of the car at the side of the tank, and a connection was made to the inside of the tank by siphon through the dome of the tank, made of two-inch wrought iron pipe with the necessary fittings. The driver with one man to pump was able to leave the street, go to the car and fill his three 52-gallon barrels and return in exactly thirty minutes.

A strip was taken on one side of the street about fifteen feet wide, the street not being closed to traffic, and three men, each armed with a large two-gallon garden sprinkling can, with spray removed, poured the oil on the pulverized surface each man working in his own section, about twenty feet long, the driver filling the sprinklers by pumping from the barrels with a tin oil pump. The writer inaugurated this system of distributing oil during the mosquito campaign of the previous year (1905) and found it very satisfactory.

A load of coarse sand was dropped about every fifty feet on the oiled strip, and during the absence of the wagon in refilling the barrels this sand was spread by the men in the same manner that sand is applied over a newly grouted brick pavement in thin layer.

After one side was oiled and sanded, a strip on the other side was treated likewise, and the center strip was again plowed and harrowed, having become compacted by traffic, and also treated, after which the whole street was run over with a toothed harrow, and was then gone over and oiled and sanded a second time but was not harrowed. The street was then thrown open to traffic.

This was all done the first week in July and until recently, there has been comparatively little dust and no mud, nor has there been any more washing where formerly it was excessive after a hard rain, and we have had several hard rains this summer, one quite soon after the street was treated. I am of the opinion that the oil should have been renewed within sixty days.

We were, I think, fortunate in having rather hot weather in which to apply the oil. The gutters have still a good percentage of the oil retained, and the sod was enabled to make a good set, which of course reduces the wash. Time was taken in unloading one wagon (three 52-gal. bbls.), and it took three men exactly one hour to dispose of the load over a surface of 15x100 feet, or 1,500 square feet. One man scattered with a shovel one wagon load (about 24 cubic feet) of sand over an area of 50x60 feet, or 3,000 square feet in fifteen minutes.

The oil was charged at $1.59 per 44-gallon bbl.

Team, 7 days at $3.00	$ 21.00
Labor, 11 days at $1.25	16.75
Foreman, 3 1-2 days at $1.50	5.25
Total, labor account	$ 43.00
Oil, 47.14 bbls. at $1.59	$ 74.79
Sand, 35 loads at 75c	26.25
Total, materials	$101.20
Total, all items	$144.20

THE USE OF TAR ON ROADS.*

By James Owen, County Engineer, Newark, N. J.

While the users of the present improved highways, either in carriages, wagons or automobiles, have probably not noticed a more rapid deterioration of the roadways it has become apparent to those in charge of their construction and maintenance that more care and more money is required to keep the surface up to the proper standard; it is therefore obvious that with the probable enormous increase of automobile and other travel due to the perfection of surface, other means and methods should be sought that will be more efficacious and also as economical.

Another source of trouble arising from the extended use of the highways is the dust. This is of such extent that it is not only troublesome to the traveling public, but a positive injury to abutting property, whether residential or used for farming. In fact, fruit raising near a much used highway is almost a thing of the past. This dust nuisance has been the cause of recent investigations in Europe of means and methods for its abolition, and it will be in order to give a brief outline of experiences and results.

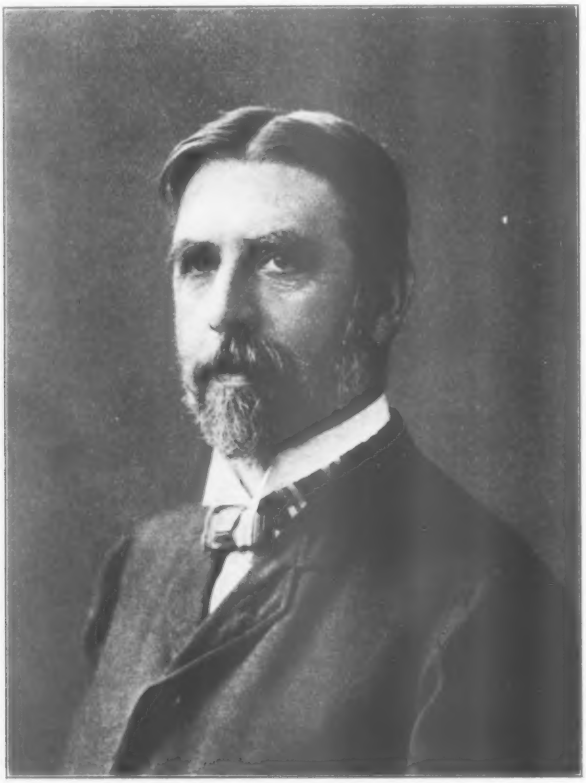
In congested communities, able to afford it, the past practice has been to use water, by periodically sprinkling it on the surface. This has suppressed the dust, but it has the effect of rapidly rotting the roadway unless extreme care is used in the application. Of later years other material has been used such as tar and crude oil, and in the consideration of these extraneous materials I will give a short outline of what has been done and attempted in Europe and this country.

France seems to have been the first country to consider the subject, for in 1880 the engineers at Saint Fay la Garde used tar, but the undertaking was not a success. In Oran, Africa, in 1898, M. Cardy had some roads oiled with aloe oil and massat oil and the results were so favorable that other towns in Algiers adopted the process. In 1898, however, extensive experiments were begun in California and 80 miles of roads were successfully sprinkled with oil. In 1900 engineer Rimini of France prepared a patent mixture of tar with a drier, the mixture being intended to hasten the drying process, but it did not give good results. In 1901 experiments were made in France with tar and oil, and since then experiments have been conducted in various localities in that country with all kinds of material, especially tar. The tar manifested such a superiority over any other material that it was used exclusively in the further experiments for its practical application. The results of the investigation for proper application of tar in France may be summarized as follows: The application must be undertaken only in dry weather. The roadway must be perfectly clean, dry and well kept. The

*From a paper before the American Society of Municipal Improvements.

tar will not stick if the roadway is damp but becomes loose after a short time. In cold weather the tar becomes stiff too quickly and does not spread, besides it does not penetrate the surface of the road. If the latter is not entirely clean and free from dust the tar does not cling to it but becomes mixed with the dust when it is spread on the road.

In the application of the tar to the surface it was found that better results were



FIRST VICE-PRES. JAS. OWEN,
Newark, N. J.

achieved if the tar was heated to a sufficient temperature to enable it to flow freely, about 200 degrees F. Many devices have been originated for properly heating and distributing the hot tar. One, used at Neuilly, consists of a hearth with a tar reservoir over it, and a smokestack to increase the draught. Two kettles are used at one time, so that the tar can be warmed in one while the other is in use. The material is poured into pots with an open spout and poured on the surface. This plant is for a moderate application.

For large stretches a large plant was designed by M. Audoin, consisting of a sprinkling barrel which consists of a cylinder of about two liters capacity which rests upon a two-wheeled truck and is filled by means of a pump. The tank is warmed by a portable hearth which is pulled from under the cylinder after the proper temperature has been attained. At the rear of the tank there is, as in sprinklers, a distributing pipe with a number of holes which spread the tar for a distance of five feet. The contents of the tank are sufficient for covering a length of 375 feet. If smaller tanks are used, or even simple sprinkling pots with open nozzles, the tar is spread over by means of broom to insure even distribution.

In France it was found that before a tarred roadway is given over to traffic it is necessary to sprinkle the tar with a coating of sand. The same further hardens the tar, protects it and prevents slipping of horses. It was found that the sand should be scattered after the tar has been allowed to harden for two or

three days. Attempts have been made however, to coat a road with tar and sprinkle it with sand, and immediately turn the street over to traffic. Some of the sections do not seem to wear as well as the sections where the coating was given two or three days to harden. Others wore quite as well in spite of immediate subjection to traffic. To spread over the tar a rather coarse gravelly sand was used, occasionally fine sand, and here and there the street dust which had been swept together just before tarring. It is to be noted that gravel and gravelly sand gave bad results, for the larger pieces were forced into the tar coat under the action of traffic and made holes. By

The results of the tar application in France were found to be as follows:

August 1st, 1902, a section of road about 370 feet long and 12 feet wide at Champetery was tarred. It had lately been repaired with slag and gravel and was in good condition. Travel was small. From August to November, 1902, the coating wore well, no dust or mud, and the street dried well after storms. From November, 1902, to April, 1903, several traces of wear were discernible, the stones showing through. During a rainy period the tar layer raised in places and formed with the tar remnants which came out at the denuded spots in a thick sticky slime, which after drying served as a coating.

PREVENTION OF DUST ON MACADAM ROAD.
Spreading and sweeping in Tarvia.

the use of street sweepings better results were obtained, although this is inferior to river sand. The street sweeping dust absorbs certain lighter parts of the coating. The best sprinkling material is fine sand, which was used on a section in the proportion of about 1 cubic meter to 2,000 square meters of tarred road. It is advisable to stop traffic entirely two or three days during the hardening of the tar. Where this is not feasible and would cause much inconvenience, first one half and then the other half of the street may be tarred. The period of hardening for the tar varies between two and five days according to the temperature, situation of the street (i. e., if exposed to wind or not) the composition of the tar materials etc. By the addition of heavy oils the period of hardening may be lessened,

From April to July, 1903, the tar disappeared in places chiefly in the middle of the road. In July, 1903, the Avenue de la Tourelle in Sainte Mande was tarred. This avenue, which has a very heavy bicycle and automobile traffic, had a limestone surface laid in May, 1903. The tarring was done in July, same year, in damp cool weather, and the results were excellent. The tar disappeared in places where the surface was not entirely dry when it was applied. This road was retarred in June, 1904, and there was still tar in places although not enough to prevent dust.

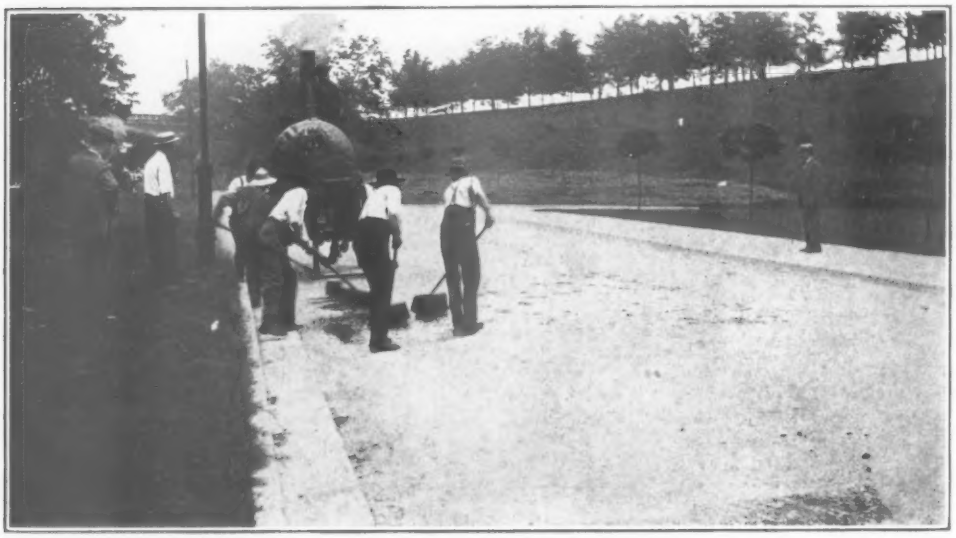
These and other experiments show that the tarring of the surface lasts about a year, and during that time there is no dust and little mud. It is however, the unanimous view of the French experts

that the wear of the roadway is increased through the tarring process. This can readily be appreciated since there is little dust and hence less abrasion of the stone. The tar surface is also waterproof and prevents deterioration from penetration of the water. There is also a strong claim made as to the benefit of tar as a hygienic measure as it has a decided antiseptic action.

In England exclusive use is also made of tar for the maintenance of the surface of the roads and prevention of dust.

In this country the use of tar has become a recognized practice, although at present it is not extensive. One of the first applications was made in Jackson, Tenn., where a very successful experiment was made on practically the same lines as in France. The tar was heated to a temperature of 210 degrees, run over the road through a one and one-half inch hose with a one inch nozzle. The surface of the roadway was then broomed and covered with a light coating of clean sand and screenings and rolled with a steam roller. This coating lasted about seven months. A section cut through the surface showed that the tar had penetrated one to two inches.

The town of Montclair, N. J., in the year of 1894, coated one of its streets on a steep grade with a mixture of tar and screenings and after a year of use it showed little result of wear. At this time patches of the original surface are now visible showing the wear. This year the town has covered about a mile of roads and their surface is universally satisfactory, perfectly clean and smooth with no dust or mud. The cost of the 3,400 feet treated this year was 30 cents per lineal foot or 17 cents per square yard. This included 300 yards of cracked stone and screenings and if this item be eliminated from the outlay it will be found that the cost of tarring alone would be about 5.66 cents per square yard, comparing favorably with the French result. The authorities of the Village of South Orange, N. J., are also extensively repairing the streets with tar, with good results, and the Borough of Queens, New York, has also treated miles of its roads in the same way.



PREVENTION OF DUST ON MACADAM ROAD.
Brushing in screenings over coat of Tarvia, finishing the process.

There seems to be one radical difference between the French practice and that adopted here. In France they merely sprinkle the surface of the spread tar with sand, especially rejecting gravel, as they find the coarse material breaks up the surface of the hardened tar. In this country a coating of screenings is universally spread upon the tar with the design of incorporating as much as possible the tar with the dust. Taking the practice in this country of using stone dust we find of course a large increase in cost by the extra price of the stone. On the other hand we have the saving of wear on the road itself by the fact that the tar and dust mixture acts as a cushion and lessens abrasion.

In this country a material has been put

on the market known as Tarvia, which is being extensively used as the means of allaying dust, and so far its application fills the want for immediate delivery of a tar preparation for road surfacing. Whether in the larger use of tar in the future its market price will be as economical as the use of ordinary coal tar is a fact that remains to be proved.

Tar as a medium for binding stone is no recent innovation. Years ago tar pavements were in great demand and use, and some of them are in existence today, but the knowledge of its use and properties is much more intimate than it was at that period.

EARTH SETTLEMENT IN CITY STREETS.*

By Horace Andrews, Consulting Engineer, Albany, N. Y.

This paper is in large part, a compilation of material that exists in a very scattered condition. The writer has endeavored to make his practical recommendations a summary of the best usage and has drawn upon his own experience in many years of observation with clayey soil and a severe winter climate.

Composition of Soil.—The composition and physical characteristics of the soil upon which buildings and street pavements rest influence the permanence of these constructions.

Geologists define a rock as "any bed, layer, or mass of the material of the earth's crust," but as this word in common language is understood to apply solely to the consolidated material, it is better and more usual to employ the words soil or earth to distinguish the loose material derived from the disintegration of the harder rocks.

From the agriculturist's point of view the physical properties of soils have been investigated with great care. Less attention however seems to have been paid to the causes of their shrinkage and expansion, which are of more importance to the engineer.

The soil consists of (1) mineral grains of various sizes, grouped in different ways and either insoluble in water or soluble with difficulty, (2) the water which covers the soil grains and contains in solution a varying amount of the soluble soil constituents and (3) the soil atmosphere, differing only slightly from air in composition and saturated, usually, with water vapor."

Texture and Structure.—The texture of the soil refers to the different size of the soil grains, while the arrangement of the grains in respect to one another has been termed its structure. By a change in structure of any particular soil, the change in the mean size of the interstitial spaces is understood; when a soil shrinks these spaces must diminish in size, while their enlargement will also increase the entire volume of the soil.

A gravel soil of very coarse texture may have the same percentage of voids as very fine sand. By mixing soils of different texture together the percentage of voids may be diminished, whether the separate grains are large or small, provided that the smaller grains will just about fill the voids between the larger. "In a heavy clay soil, one-half of the dry weight may be made up of soil grains as small as 1-25,000 of an inch in diameter." (King.)

Water in Soils.—If the spaces between the grains of soil are entirely filled with water, the grains are generally capable of being moved more easily by packing or ramming the soil. When thus consolidated the soil is said to be puddled. "When a fine grained soil is thoroughly puddled, all of the small clusters of grains are completely broken down, and the smallest particles are packed in between the larger ones until its cavities are so completely obliterated that even water will not penetrate it" (King.) However compactly puddled a soil may be, its water contents will be large, and when the water is lost by evaporation the soil grains seem capable of approaching each other, as is noticeable in the shrinkage of clay. Hence it may be concluded that the water in the interstices actually holds the grains apart.

Puddled material may hold its grains so completely filled with water that little free air is present, except that absorbed in the water itself. This "water-logged" soil is of great importance in the construction of embankments to retain water, as in reservoirs, in which position it readily maintains its puddled character.

Prof. F. H. King, in his work on "Irrigation and Drainage" gives information as to the capacity of soils to store water. "A fine sand which held in the first foot above the ground-water 23.86 per cent of its dry weight of water, at 8 feet above was found to hold only 3.14 per cent of the dry weight;" a cubic foot of the dry sand weighing 105 lbs. The loss he attributes chiefly to downward drainage or percolation and also to upward capillary

*From a paper before the American Society of Municipal Improvements.

movement and surface evaporation. Many soils when they become very dry, develop shrinkage cracks, but repeated small applications of water will again saturate the soil to some degree and it will then expand and close up the shrinkage cracks. Prof. King comments upon the drying of clay soil as follows: "The firm hard character of a clay soil when it loses its moisture is due to the fact that the grains are so small and so close together that the little material which is held in solution in the soil-water cements them together when dry. Were the grains large like those of the sands, with few of the fine particles between them, the contact areas would be so few and so small that little binding would result."

This theory of Prof. King is not entirely corroborated by the experiments in the Road Material Laboratory, Dept. of Agriculture, for Mr. A. S. Cushman, commenting on the cementing value of the powders of various rocks, says: "Rocks which, on chemical analysis, show themselves essentially identical in composition frequently vary widely in cementing value." He considers the classification of materials according to the size of the particles into silts and clays to be incorrect and shows that powdered glass in the finest state of subdivision has no cementing value whatever. The difference in cohesion that exists between various materials in the same state of subdivision does not yet seem to have been adequately explained. Mr. Cushman's experiments show that high cementing values have a tendency to accompany a high water content but exceptions occur.

HORACE ANDREWS,
Consulting Engineer, Albany, N. Y.

Effects of Frost.—The effect of freezing in expanding soils will serve as an index to the water content and will further indicate that a loss of this water by evaporation or drainage will prevent lifting by frost. Where man-holes are built in sidewalks the effect of frost is frequently visible in a raising of flag stones above the man-hole rim. This lifting has been observed by the writer to amount to as much as two inches. The specific gravity of ice is about 0.92; one cubic foot of water will become 1.087 cubic feet of ice. Soil containing 20 per cent of water in its interstices might therefore reasonably be expected to rise about 0.1 ft. when it freezes to the depth of 3 1-2 feet. The necessity of maintaining a dry foundation in such cases is obvious.

It is shown, in the levels taken on the asphalted surface of Center Market in Albany, hereinafter referred to, that frost at its first occurrence may raise the surface and that this raising will be permanent. Many brick pavements are cracked in a manner difficult of explanation except by the raising action of frost. Pavements laid on dry soil and especially where a period of many weeks allows of some lessening of the water contents by percolation before severe frosts occur, seem less apt to suffer from the lifting effects of frost.

Compression Under Loading.—Very dry materials are readily compacted by ramming or rolling. A sand cushion 1 3-4 inches deep is compressed to 1 1-2 inches after rolling, when used as a cushion for a brick pavement. Rolling the foundation of a pavement, in some soils, will bring more moisture to the surface, by capillary attraction, from depths as great as four feet. The writer has seen a 10 ton steam roller sink so deeply into a clay sub-foundation that it could be moved again only after prolonged work in digging it out. The rolling in this case had the effect of softening the foundation. Usually a compression by rolling, with a weight per inch of run of roller as great as the maximum wheel load the pavement will be called upon to bear, is desirable, but in the case of wet clays a very light rolling or tamping is all that can be done in the way of consolidation.

Supporting Power of Soils.—Sometimes embankments for city streets have to be formed on soft and yielding soils, such, for example as the salt marsh at Hoboken, N. J., described by Mr. Thos. H. McCann (Trans. Am. Soc. C. E. Mch. 17, 1897.) The depth of this marsh was from 30 to 100 feet. "There is little displacement of the meadow at the sides of the fill where the latter is not more than 10 or 12 feet deep, but where it reaches greater depths, the meadow is forced up." "First, there is a compression and displacement of the lighter and softer marsh by the heavier filling; second, a shrink-

age of the filling material and about the time the road is finished the embankment is floating, so to speak, on the marsh; third, the embankment settles gradually, compressing or displacing (in many cases both) the softer marsh. This settlement continues for many years, and, of course, is greatest in a road on which there is a heavy traffic."

Where a city street is to be formed by embankment, made upon ground of almost any nature, and prolonged settlement is undesirable, it would be expedient to dig out a trench for the foundation, in the first place; or at least the material beneath the center of the embankment could be scraped to the sides, to form a portion of the side slopes, without much increase in cost. The writer has computed the accompanying table for convenience of use in this connection, from Prof. Rankine's somewhat involved formulas, to indicate the ratio of depth of trench to height of embankment for various cases.

ANGLE OF REPOSE OF NATURAL GROUND.

W'÷W	0°	10°	15°	20°	25°	30°	35°	40°	45°
0.5			2.25	0.92	0.49	0.29	0.17	0.10	0.06
.6		4.76	1.36	.67	.38	.23	.14	.09	.05
.7		2.43	0.98	.52	.31	.20	.12	.07	.04
.8		1.63	.76	.43	.26	.16	.10	.06	.04
.9		1.23	.62	.36	.22	.14	.09	.06	.03
1.0		0.98	.53	.32	.20	.12	.08	.05	.03
1.1	10.	.82	.46	.28	.18	.11	.07	.04	.03
1.2	5.	.70	.40	.25	.16	.10	.07	.04	.02
1.3	3.33	.62	.36	.23	.14	.09	.06	.04	.02
1.4	2.50	.55	.33	.21	.13	.09	.06	.04	.02
1.5	2.	.49	.30	.19	.12	.08	.05	.03	.02
1.6	1.67	.45	.28	.18	.12	.08	.05	.03	.02
1.7	1.43	.41	.26	.16	.11	.07	.04	.03	.02
1.8	1.25	.38	.24	.15	.10	.07	.04	.03	.02
1.9	1.11	.35	.22	.14	.10	.06	.04	.02	.02
2.0	1.	.33	.21	.14	.09	.06	.04	.02	.02

W' equals weight per cubic foot of natural ground.
W equals weight per cubic foot of embankment.
The table gives values of co-efficient by which height of embankment must be multiplied to find depth of cutting below natural surface, to insure stability of bank.

Embankments and Cuttings.—Both the English and the American practice is to assume that soil removed from cuttings will not measure as much in a settled bank as it did in the original cutting. Mr. P. J. Flynn has discussed this matter in an interesting paper before the Technical Society of the Pacific Coast, June 5, 1885. He comments as follows:

"The disagreement of the German authors from the American and English practice as to shrinkage is certainly remarkable. The Germans give on the whole, a permanent increase for sands, clays, and similar materials: but on the contrary the Americans and English give a diminution." Prof. Baker, in his admirable treatise on "Roads and Pavements" summarizes the reasons for the shrinkage of earth embankments as follows:

"(1) The continued action of frost has made the soil in its natural position more or less porous.

(2) Earths which have been lying in situ for centuries become more or less porous through the slow solution of their soluble constituents by percolating water.

(3) The surface soil is rendered more or less porous by the penetration of vegetable roots which subsequently decay.

(4) There is ordinarily more or less soil lost or wasted in transporting it from the excavation to the embankment."

It appears to the writer that a fifth and very important cause of shrinkage arises from the change in water content of the soil. In an embankment, drainage and evaporation can reasonably be assumed to deprive the soil of much of the moisture it contained while in its original bed. The deprivation of moisture will cause more shrinkage in clay than any practicable consolidation by mechanical means. The writer made the following experiment regarding their shrinkage. A section of undisturbed clay was removed from a depth of four feet below the surface of a sidewalk in the city of Albany, and was carefully trimmed to dimensions, without disturbance of the natural layers. The clay was good brick-clay and contained apparently less moisture than at lower depths. It was found to weigh 119 lbs. per cubic foot. It was exposed to natural summer atmosphere in August, in a shaded place, the humidity of the air being from 40 to 70 per cent. Pins were placed in the clay and measurements made between them from time to time. At the end of two days the clay had divided into two parts along a plane of stratification about in its center, but no other cracks of any magnitude appeared during the progress of the experiment. Its loss of weight was then 12 per cent of the original weight and the distance between the pins had contracted by 6.3 per cent. After six days drying, the clay, which at that time ap-

peared quite dry and hard, was again carefully measured and weighed. It had then shrunk to 86.9 per cent of its original volume, and weighed 105 lbs. per cubic foot, the distance between the pins had shortened by 7 3-4 per cent and the weight had diminished by 23 per cent of its original amount. The water in the pores of the clay still continued to evaporate, however, and at the end of two weeks the entire loss was 28 per cent of the original weight. This compact clay therefore contained about 38.8 per cent of its dry weight of water. Although it was, when first dug out, packed much more firmly than any ordinary consolidation by mechanical means could have effected, nevertheless it was capable of a shrinkage in volume of over 13 per cent. by evaporation alone. This experiment indicates that in clay soils, and possibly in others, the loss of water by drainage and evaporation may account for much shrinkage and settlement. It has been observed that a brick from a stiff-mud machine will shrink from 5.7 to 10 per cent in its linear dimensions on leaving the drier. (Tr. Am. Soc. C. E. Vol. 29, p. 664.)

Mr. Eliot C. Clarke instances a case in connection with the main drainage works of Boston where a deep trench "drained the water out of the adjacent soil, rendering it spongy and somewhat compressible, so that the whole street settled and had to be resurfaced and repaved."

Referring again to the table computed from Prof. Rankine's formulas, it is seen that just as a ship sinks a certain distance into the water before it is held in equilibrium (the angle of repose of the water being zero) so an embankment may be found to sink into the natural soil and thus appear to shrink and occupy less volume than when its material was removed from its original position. Even with an angle of repose of 30 degrees and with natural soil of the same density as that of the embankment, the table indicates that ultimate stability will only be attained when a settlement—or apparent shrinkage—of 12 per cent has occurred. This settlement may be extremely slow and the embankment may for years be in an unstable condition, for the angle of repose is a somewhat uncertain and variable quantity and will be affected also by changes of water content in the interstices of the soil. It is not maintained by the writer that subsidence as great as the tabular amounts may be expected under every embankment. The compression of the soil by the weight of the embankment may soon increase its density and thus retard further settlement, still it is reasonable to suppose that part of the assumed shrinkage of earthwork may be due to an actual subsidence into the underlying natural soil. The whole matter of the shrinkage of earthwork does not seem to have been investigated very scientifically. To this end the amount of water contained in the soil before removal from the cutting and the weight of the soil per cubic foot both in its natural condition and after drying completely, without disturbance, should be ascertained and the same data should be secured from the embankment, at various depths and at different lengths of time, while careful notes should be made as to the physical character of the soil, the amount of rainfall and the method of depositing the earth in the embankment. Borings or test pits should also be made to show the amount of subsidence of the embankment into the natural soil.

In these portions of the city of Albany where the subsoil is a dense, wet clay, precautions are sometimes taken to maintain the moisture at its normal amount. Under certain buildings this has been secured by irrigating the foundation. Trees are occasionally cut down when their roots are thought to have too great an effect upon the drying of the soil.

Where streets are covered with water-tight pavement, the entire street surface in some cases seems to settle slowly for many years in a manner that it is difficult to account for except by a slow drying out of the water contents of the clayey sub-soil. In this case a renewal of the pavement with a re-surfacing of the original concrete base should effect a permanent improvement.

Under a water-tight pavement there is probably at first a certain loss of water by downward percolation, until a condition of equilibrium is reached, when capillary attraction thereafter maintains a nearly fixed amount of water drawn from the underlying ground-water.

The writer has investigated the actual changes in level of Center Market in Albany. The site of this market, comprising 7,461 square yards of asphalt pavement, was covered with buildings and by the adjacent sidewalks. The buildings were removed in 1888 and the site was graded in December of that year, there being no filling except in the cellars of the houses. A sheet asphalt pavement on a six inch concrete base was laid in the summer of 1889. Numerous brass caps were placed in the asphalt, with their bases resting on the concrete, at intervals of about 44 feet. The levels of these were determined in December 1889, over about 3,000 sq. yards of the area. The levels were repeated in March 1891, 15 months after the first and while there was frost in the

ground. 19 of the brass caps were found to have risen 0.031 ft. on an average, while 9 had sunk 0.016 feet on an average. The greatest rise was 0.078 ft. and the greatest settlement was 0.033 ft. The levels were repeated September, 1906, 16 years, 9 months after the first levels, the asphalt having remained undisturbed meanwhile, but in daily use; 21 of the caps were then found to have sunk from 0.002 ft. to 0.222 ft., the average settlement of of 0.059 ft. being partly attributable to slight wear of the brass caps. The remaining seven caps were from 0.001 ft. to 0.016 ft. higher than originally observed and it would appear with these as if the heaving observed in March, 1891, had never been entirely overcome by subsequent settlement.

Consolidation.—Consolidation of undisturbed soil is best effected by rolling with as heavy a roller as the nature of the soil will permit. Where, as has already been pointed out in the case of clay subsoil, a light roller must be used it should be passed over the surface a greater number of times than would otherwise be necessary and the roller should be used transversely, as far as this may be practicable, as well as longitudinally. Where a roller can not be used, for lack of room, tamping by hand must be resorted to. This is very laborious work and is frequently slighted. Large embankments are sometimes consolidated by rollers, but generally their use in this connection is restricted to embankments for retaining water.

The most vexatious irregularities in city streets are caused by the cutting of trenches without sufficient effort to obtain, or indeed where it may be nearly impossible to secure the ultimate settlement before the pavement is laid. Where the ground is quite pervious to moisture and it is well underdrained, a very liberal use of water will cause grains of sand and gravel of different size to pack closely and the surplus water will drain off, thus effecting a very compact and unshrinking filling. With retentive and wet soil and clay back-filling the use of water will most certainly be followed by slow settlement, which may continue for many years with disastrous effect upon street pavements or sidewalks. Where a cut must be made in an existing pavement and the soil on the sides of the trench is retentive to moisture, dry granular material should be used for the back-filling. This filling need not be of an expensive nature, steam-ashes, or rubbish, such as broken bricks and mortar from the removal of old buildings—called "hard-core" in England—will answer the purpose well. Very careful and thorough pounding is essential, if clay and loam are used for back-filling, and even then it will be found quite impossible to pack lumps of clay without leaving large voids, even if the rammer has a small cross section. This latter requirement is essential if clods of clay are to be broken; a light rammer also will be more efficient in securing good work than a heavy one which will soon exhaust the laborer. The writer believes that back-filling of trenches where no subsequent settlement is to take place can only be secured, in many soils, by the use of other power than human muscles for the tamping. A given expenditure of money should secure better results through tamping with compressed air, steam, or some similar source of power than where human muscular effort is relied on. Earth filling is said to have been very perfectly consolidated by the feet of goats in the formation of puddled walls for reservoirs, but in city streets such means of tamping loose material would seem to be impracticable. In contract work involving the back-filling of trenches, the writer secured great improvement in the pounding of the filling by making the number of days labor for this end one of the items in the approximate quantities and by inserting the following clauses in the specifications:

Back-filling of Trenches.—All back-filling is to be well and thoroughly pounded in thin layers. The number of men back-filling is never to exceed that of the men pounding. The contractor is to be responsible for all settlement over the lines of trench, and to take up and relay the concrete and pavement if such settlement causes perceptible hollows in the pavement during the five years period of guarantee. Water tamping is not at any time to be used except in porous and gravelly soil. Wet clay is not in any case to be used for back-filling. Frozen material is in no case to be used for back-filling.

Price Paid for Labor.—For labor actually performed upon the work of pounding the material filled into trenches, the contractor will be paid in accordance with his price bid for each day's labor. The amount of such labor is to be verified by the inspector and is to be expressed in days and hours.

The object sought was to secure from the contractor, work on the pounding with no pecuniary loss to him.. From motives of expediency it was found that the contractor invariably made his bid at the prevailing rate of wages.

Miscellaneous Trenches.—In case a pavement is under guarantee of maintenance for a term of years it has been the practice of the writer to provide that the contractor shall do all back-filling of trenches where cuts are made in his pavement during the period of guarantee, in accordance with the following specification:

Prices to be Paid for Repairs to Cuttings.—All back filling to be of selected dry material, acceptable to the City Engineer, and thoroughly tamped in place in thin layers, to be furnished and tamped at the rate of 75 cents per cubic yard for the first ten cubic yards, and at the rate of 60 cents per cubic yard for each yard over the first ten cubic yards. The above prices to include the removal of the old material excavated. In case the old material excavated is, in the opinion of the City Engineer, suitable for back-filling, it must be so used and one-third the prices named above for new material will be paid for the tamping and consolidation of such old material.

Other clauses provide for the re-paving over cuts, and for the terms of payment for this, also that the contractor's guarantee of maintenance shall apply to all such repairs as well as to his original work.

In the miscellaneous cuttings in paved streets, it would seem proper, and indeed quite essential, if prolonged settlement is to be avoided, that the work of back-filling should be done entirely by the laborers of the city, under competent supervision. The regulations of the city of Washington seem admirably designed to secure good work in this respect. The back-filling and repairing are done by the city at fixed prices, which are charged against those to whom permits are issued. Deposits from all plumbers are required and when the charges against any plumber are found to be exhausting or depleting his deposit he is required to make good the deficiency or to have all future permits for cuts withheld. Most of the evidence available indicates that it is very difficult, but not impossible, to replace all of the old material excavated, where the tamping depends upon the muscular efforts of laborers. With small excavations as, for example, post holes, the laborer retains sufficient energy to replace all the material excavated notwithstanding the comparatively large volume occupied by the post. With trenches for laying pipes, the space actually required for a sewer or water pipe should be taken into consideration. The writer has devised the following convenient rule for ascertaining the displacement due to sewer pipe: "The number of cubic yards displaced by 100 feet of pipe is equal to 0.03 of the square of the pipe's inside diameter in inches." The rule assumes the pipe to be laid in two ft. lengths and under that supposition makes allowance for the hubs. For example, a 10 inch pipe is found to displace 3 cubic yards per 100 feet by the above rule, more exactly this should be 2.94 cubic yards; while a 30 inch pipe displaces 27 cubic yards; the rule being quite precise for this and other large sizes of pipe.

Provision for Protracted Settlement.—Even with faithful work it seems nearly impossible to avoid some settlement in clayey back-filling, and as the subsidence will continue for several years, it may be expedient in some cases, as for example with deep filling within retaining walls at bridge approaches, to provide temporary pavements and sidewalks, with the intention of replacing these with more permanent ones in the future.

As stated in a "Special Consular Report on Streets and Highways in Foreign Countries" in 1891, the City of Frankfort-on-the-Main, having a soil which "forms an uncertain and treacherous foundation for pavements, especially when the original earth has been previously disturbed by the laying of sewers or water mains," makes a practice of laying temporary stone block pavements and "after some years of use have thoroughly settled and solidified the ground to take up the temporary pavement" and re-lay a permanent pavement in its place.

Although this procedure seems an open acknowledgement of defeat in the conflict, still it may be the part of wisdom and expediency to allow the forces of nature to do their worst in the matter of earth settlement and afterwards to found pavements and sidewalks upon the thoroughly established surface.

Time, indeed is the potent factor in securing stability, but a careful study of the peculiarities of the soil, with watchful care and a very liberal expenditure of energy in consolidating the filling, may in a great measure supplant the necessity of long waiting for ultimate settlement.

CHERT ROADS.

By Prof. E. B. Kay, Univ. of Alabama, Tallapoosa.

"Chert or flint is one of the hardest of rocks;" it does not usually occur in considerable quantities in its original beds, but is everywhere mixed with more or less lime stone or sand stone, so that beds of pure chert often grade imperceptibly into pure lime stone or pure sand stone. Determinations made by the Department of Agriculture at Washington, Office of Public Roads, Division of Tests, give the following maximum and minimum results of some thirty samples, corrected to July 1, 1906:

These tests, made by the Government

Office of Public Roads, show that chert exceeds in hardness any material ordinarily used for road building. The cementing value tests of chert do not compare favorably with trap rock, limestones and other road materials, since the essential mineral of chert (which is quartz, a mineral of practically no cementing value) represents from 83 to 99 per cent of the composition. However, the accessory and secondary minerals of chert, such as pyrite, magnetite, limonite, calcite, and chlorite, have high cementing values, and cherts when used as road materials almost always increase in cementing value after being exposed to traffic.

CHERT	Maximum	Minimum	Average
Specific gravity	2.90	2.00	2.50
Weight—pounds per cubic foot	1.81	1.25	1.56
Water absorbed—pounds per cubic foot	11.10	0.46	
Per cent of wear	27.89	2.7	
French co-efficient of wear	14.6	1.4	
Hardness	19.6	19.1	
Toughness	21.0	7.0	
Cementing value—dry	36.0	1.0	
Cementing value—wet	106.0	5.0	

Chert has a splintery or conchoidal fracture, and in color ranges from pure white to black, neutral gray, brown, yellow or red.

It is found in the lower carboniferous formation and in the Knox Dolomite of the Silurian or Cambrian. In the former it is generally in more or less regular beds or sheets; ;in the latter, usually in the form of concretionary masses. Geographically it is found in the sub-Carboniferous and Silurian outcrops in Alabama, and extending through the northeastern part of Mississippi, thence through western Kentucky, crossing southern Illinois and Missouri, then down through the state of Arkansas and into Oklahoma. The name of hornstone was more frequently employed for the same substance. In Illinois it is known sometimes as novaculite, but is unlike the true novaculites found in the hilly regions south of the Coal Measures in Arkansas, from which the famous Arkansas whetstones are made.

There are extensive chert quarries in Alabama, near Florence, Ft. Payne, Birmingham, Leeds, Bessemer, Anniston, Jacksonville and other cities and towns. In the Birmingham district, it is found in inexhaustible supply, overlying the red sandstone, which forms the covering for the big vein of red hematite ore and underlying the sub-carboniferous limestone. The chert of the sub-carboniferous formation contains between the cleavage joints, a proportion of clay and iron oxide, and although the bank chert is sometimes comparatively soft until it is spread on the ground, it generally makes a better roadway than the hard material. In Alabama, the chert from the Silurian formation is harder and more expensive to quarry and does not make as good road material as that from the upper formation. All the cherts of Alabama are easily quarried, however, by blasting, and the lumps are reduced to proper size by napping hammers or by rolling. There is an extensive chert quarry in Tishomingo County, Miss., and in Alexander County, Illinois, at Elco, there is a chert bed about 150 feet in thickness. It is located on the Mobile & Ohio Railroad about 24 miles above Cairo. The chert is obtained by blasting, is run through a crusher and loaded on cars by the use of steam shovel. This chert, besides being used as a road material, is used as ballast on the St. Louis Div. of the M. & O. R. R. and to replace wooden platforms at stations. Where cherts are found in banks or beds of streams, they are commonly called gravel. Creek gravel, formed from chert or novaculite is usually of uniform size and comparatively clean, while the bank gravel often contains earthy matter and fine particles of the same material. The creek gravel usually wears the best, but it does not bind so readily, or form as smooth a surface as the bank deposits. These gravels are widely distributed over southeast Missouri and in Jasper County the cherty refuse from the zinc mines is utilized for road making. In Arkansas, the cherts (in place) are confined to the area lying north of the Boston Mountains and west of the Iron Mountain Railway. "There are two horizons at which it occurs in large quantities: The first is that of the Boone chert and cherty limestone lying at or near the base of the Carboniferous series of rocks; the second is the great chert beds lying far below the Boone chert, geologically speaking, and exposed in the counties through which the upper White River flows. The Boone chert begins in Independence County, near Dota and forms a belt of ragged edges from 5 to 15 miles wide, crossing the State from this point, past Cushman, Mountain View, Marshall, Harrison and Eureka Springs, and forming the greater part of the surface of Benton County. All through these chert regions the beds

of the streams are filled in places to a depth of 15 feet with the accumulated small fragments of chert, most of which is in suitable condition for immediate use for road building." The chert beds that occur in the Silurian rock of north Arkansas "crop out along the stream bluffs through Randolph, Sharp, Fulton, Izard and Baxter counties, and large quantities of the broken fragments accumulate in the beds of streams where they are often in excellent condition for road metal."

Chert, as we have already noted, varies greatly in quality and appearance and upon exposure becomes hard and tough offering a strong resistance to abrasion. The Alabama cherts which contain clay and iron oxide between the cleavage joints are easily and cheaply quarried, do not require crushing, bind together

It produces a road surface that is very smooth, of considerable elasticity, but hard enough to have a low tractive resistance.

A chert road does not rut under any condition of traffic. An examination of the highways in Jefferson County, Alabama, which have been built of chert and were constructed over twenty years ago, and many of them subject to heavy traffic, will show that these roads are still smooth and in good condition, although they have had practically no repairs.

Chert does not produce a slippery road surface, and it affords a good foot hold to draw heavy loads.

It can be used on any grade. It makes a comparatively noiseless road and yields neither dust or mud.

It makes an impervious road bed and being smooth drains rapidly.

CHERT ROAD NEAR FLORENCE, ALA.

readily and make cheap roads that wear well and are smoother than roads built entirely of limestone. Mr. Sam C. Lancaster, chief engineer of the Madison County, Tenn., Good Roads Commission, commenting on chert in his "Report on Road Building in Madison County, Tenn.," says "This material seems to have been prepared in Nature's Laboratory especially for road building." Judged by the qualities required of an ideal road, we find this material to satisfy as many conditions, if not more than any other materila that is extensively used in road building.

It is low in first cost, as it is easily mined. The total cost on board cars at pits, in the Birmingham District, does not exceed 25 cents per cubic yard.

It requires no preparation, except breaking up of the larger masses, which is usually done by rolling or by napping hammers.

It is more durable than any form of dirt or macadam road.

Of light color, it does not absorb heat excessively. The color of the surface is pleasing and does not produce a glare.

"Where the material is plentiful, and where a good quality of bank gravel is available for a binder it is not necessary to go to the trouble and expense of cutting out a subgrade or to prepare earth shoulders as is done for regular macacdam." It is, however, essential that the surface course contain a sufficient quantity of good binding material, otherwise the bond will soon be broken, the material will spread and much of it will eventually be forced or washed into the side ditches. John C. Branner in his Report on Road Making Materials in Arkansas, says: "The 'ridge roads' through all the chert regions of the State bear witness to the great value of this chert as a good road making material. These roads, though seldom or never repaired, are hard, compact, dry and free from mud and dust all year round. The gravelly roads on the hills about Eureka Springs

are all of this Boone chert." The best roads in Benton, Carroll, Boone, Marion, and Searcy counties are on this same formation.

Methods of construction. Mr. M. C. Eldridge, Chief of Records U. S. Office of Public Roads, in June number, 1906, of *Good Roads Magazine*, says: "The road bed should be shaped with a road machine before the material is placed and given a slight crown of from 3-8 to 1-2 inch to the foot from the center to the sides. The foundation should then be rolled, the material for the first course spread in two layers and rolled and sprinkled in the usual manner. The spreading of the material can be accomplished by the use of a road machine, provided the gravel is not too large. The total depth may vary from 4 to 9 inches at the center, as soil and traffic may require, and gradually diminish in thickness to what is commonly called a "feather edge" at the sides. "If the most approved method is followed, shoulders should be provided to hold the material in place. The material should then be spread to a uniform depth from the center to sides." During the year 1904 the Office of Public Roads built three chert roads in southwest Missouri, at Lebanon, Springfield, and Neosho.

A complete account of the Springfield road giving methods and cost will be found in the *Good Roads Magazine* for April, 1906. The Neosho rock was easily broken by napping hammers or the steam roller and the Neosho road was built of uncrushed chert. The completed road, which was 12 feet wide and 2,640 feet long, contained 3,520 square yards of material and cost, including two culverts, 42 cents per square yard, or at the rate of $3,058.22 per mile. Total depth of the two courses of chert, consolidated, 7 inches. For full description of this road, see *Good Roads Magazine*, June, 1906.

A full description of the Madison County, Tenn., chert roads, built under direction of Mr. Sam Lancaster, will be found in the Yearbook of Department of Agriculture for 1904. Material for the Madison County roads was obtained in Alexander County, Ill. Solid foundations were first obtained by rolling. First course of stone put on 4 inches in thickness. The rolling was from the edges toward the center. Second course of finer material was put on 2 inches in thickness, the last course used being fine screenings, which was sprinkled and rolled until the whole is thoroughly compacted, having a thickness of 6 inches at the center and 4 inches at the sides. The cost of the chert per cubic yard delivered on cars at Jackson was about $1.60. The average cost of grading, preparing foundations, rolling, unloading stone, hauling it to the road, and laying it complete was $1,800.43 per mile.

SIXTH AVENUE, BIRMINGHAM, ALA.
A cherted street after nineteen years of use.

Chert roads in Alabama. A full description of the early methods of building chert roads in Jefferson County and Birmingham, Ala., will be found in *Engineering News*, Vol. xxx, No. 45, page 370, by Julian Kendrick, city engineer of Birmingham. Those roads were built without any attempt to consolidate the foundations or to compact the chert. There are probably over 200 miles of chert roads in Jefferson County with widths varying from 16 to 24 feet. In 1887 the

Gate City Land Company cherted about a mile of street, which is a part of the county road system, and the road was extended in both directions, using the same material. Although there is as heavy traffic over this road as any in the county, and it has been in constant use for 19 years, with little or no repairs the road is still in good condition. The county roads were originally built by placing upon the sub-grade, limestone crushed to pass through a two inch ring and spread 9 inches thick in center and 6 inches in thickness at the edges; over this was spread a layer of chert from 3 to 4 inches in thickness, which under traffic soon formed a smooth cemented roadway. The county has never owned a roller and none has been employed on any of the roads. The present practice is to place furnace slag upon the sub-grade, which is crowned 6 inches at center and from 12 to 18 feet in width, the slag being put on 6 inches in thickness at center and about 4 and one-half inches at sides. Chert is then placed 4 inches in thickness at center and about 2 inches on sides. The City of Birmingham has about 40 miles of chert streets or roads. Some of these streets were built by simply forming the natural material of the street and compacting it with a steam roller. The roller used by the city weighs 15 tons, weight on each 20-inch wheel 6 feet in diameter being 5 tons. On all cherted streets, a foundation course of slag is placed on the well compacted sub-grade. The slag delivered and rolled costs 80 cents per cubic yard, put on 4 inches in thickness, or nine cents per square yard. The chert costs from seventy-five cents to one dollar and twenty-five cents per cubic yard on street in place and rolled. It is spread on an average to a thickness of five inches in center and decreased to three inches at sides and rolled until smooth and compact. The center rise or crown, where chert is used at Birmingham, is about one-thirtieth of the width of the street measured from outside of gutters. Gutters are three feet wide measured from outside edge of curb. On grades, a little in excess of one thirtieth of street is used to determine center rise. There are streets in Birmingham with grades as high as fifteen per cent on which this material has been placed.

The chert now being used at Birmingham comes from banks near Bessemer. It costs about sixty cents per ton f. o. b. cars at Birmingham, including freight charge of twenty-five cents per ton, and weighs about twenty-eight hundred pounds per cubic yard on cars.

In Jefferson County where slag is not available, the foundation course is made of the harder and coarser portions of the chert used and placed from four to five inches thick; the top course being the same as where slag is employed for a foundation.

At Cairo, Illinois, the Elco chert was used on Commercial Avenue, the chief business street, on a sand foundation, thickness of chert compacted about eight inches. It has been placed for a number of years and the street is still in excellent condition. Eighth street in the same city was improved by placing a six-inch course of uncrushed chert on the sand foundation and a two-inch top course of chert crushed to pass a three-quarters inch mesh. This street after four years use is smooth and in excellent condition.

BITUMINOUS PAVEMENTS CONTAINING CRUSHED STONE.

By J. W. Howard, Consulting Engineer, New York City.

During the past twenty-five years, among many kinds of pavements I have investigated in the United States and foreign cities, none has had such a rapid rise as a relatively new type of pavement. The present use on the streets of about one hundred and fifty cities of monolithic pavements, containing crushed stone in the wearing surface, makes them worthy of careful investigation.

I will omit reference to tarring, oiling, or other method of dust reduction and semi-waterproofing of suburban macadam and other roads; as a branch of the subject requiring special treatment after the present experimental stage of this method of improving suburban roads has been passed, I will confine the attention to bituminous pavements for cities.

Sheet asphalt pavements do not contain artificial crushed stone. They are made either from natural bituminous limestone, ground and compressed as in Europe and a little in America, or from a mixture of sand, dust and asphalt cement, as in American cities. The binder course contains crushed stone, but the binder is between the foundation and the wearing surface and does not come in contact with traffic. This binder, under asphalt and in certain cases under bituminous pavements containing crushed stone, should be a

close, dense and waterproof mixture thoroughly compressed, as now prepared and used more and more, as cities learn the durability and ultimate economy of using close binder, instead of the open, loose binder which permits water to perculate through it, coming from joints at curbs, rails, man holes, etc. But binder, not being exposed to direct traffic and weather, does not need our further attention.

Asphalt blocks, as made in America, are practically crushed stone, sand and dust, cemented together with bituminous cements. They are relatively little used except in a few cities. Not being monolithic pavements, I will omit further mention of them.

The various foundations for bituminous pavements need special constructions. The

J. W. HOWARD,
Consulting Engineer, New York City.

sub-soil as for all pavements, must be properly graded, compacted and securely retained at the sides by curbs or otherwise.

If a new foundation is to be laid, it can be either the bituminous base or hydraulic cement concrete base. Whichever is used must fully sustain the very heavy steam roller needed to properly compress bituminous pavements of crushed stone. If these foundations sustain this test, there is no need of making them of undue thickness, and, therefore, of excessive cost. If the subsoil is well drained and of a firm character as when composed of stones, gravel or loam, mixed by nature or otherwise with these, then the bituminous base is of advantage to be used under bituminous pavements. The bituminous base is composed of suitable, coarse, crushed stone which should be compressed with a steam roller of at least ten tons. The surface of this base is coated with a suitable bituminous cement applied hot, letting a little surplus run down a short distance into the upper portion of the crushed stone. The bituminous base will adhere firmly to the wearing surface mixture when it is laid, and prevent displacement, or rolling of the wearing surface into depressions and ridges. Bituminous foundations have been successful for various pavements in Europe and America for about thirty-three years, and are being rapidly adopted everywhere. Another advantage of the bituminous base is the case of access through it to pipes below the street, combined with rapid repair over such pipes.

If the subsoil of a street is yielding or poorly drained, a foundation of hydraulic cement concrete should be used. Care must be taken to make the surface of this concrete rough to prevent the bituminous pavement from slipping on it and forming depressions and ridges. The simplest and best method now used is to make the concrete slightly rich in mortar, then tamp it until a film of mortar is on the surface of the concrete and immediately scatter over this surface a sufficient quantity of clean, broken stone, of about one and one-half inches in size to half cover the concrete and at once tamp the stone, about one-half the depth of the pieces, into the film of mortar and surface of the concrete. These stones will then form keys or teeth projecting into the under portion of the wearing surface when it is laid. This makes a dense, strong concrete foundation, having all voids filled with mortar and provides a rough, serrated surface, suitable for all kinds of monolithic pavements. This method of laying concrete foundations is more and more used everywhere. It should be required in all specifications for the use of bituminous pavements we are considering.

There are several weak and bad forms of hydraulic cement concrete foundations which must be guarded against. Avoid concrete lacking sufficient mortar to fill the voids between the stones. Some contractors lay such concrete not only to save cement, but for the alleged reason of providing a rough surface for retaining asphalt and other sheet pavements from slipping. This not only gives a weak foundation, but permits water to easily penetrate the concrete from below, as on many streets of Buffalo and other places, to the great injury of the wearing surfaces which are thereby often disintegrated or at least displaced by alternate thawing and freezing of the water. The concrete itself suffers by the same actions.

We must prevent a concrete foundation

from being roughened on its surface by the bad process of only partly tamping the concrete and thereby only partly displacing the mortar of the concrete and not forcing it up into all the voids from its original position in the lower portion or bottom of the mass, which it may take at first. This partial tamping may leave stones at the top of the mass, but such incomplete tamping leaves voids in the concrete. The resulting foundation is not uniform, dense, waterproof, strong nor durable. The surface is not uniformly roughened, but consists of holes and bunches with projecting and loose stones all over it. Thorough tamping is what all engineers insist upon. The evidence of such tamping is a slight excess of mortar forced to the surface of a concrete.

There is another group of foundations which are successfully used with great economy under bituminous pavements. This group consists of old pavements prepared in several ways.

If the old pavement is sheet asphalt, asphalt blocks, brick, stone, wood blocks or other pavement with a firm foundation of concrete, crushed stone or their equivalent, the best way is to remove the old pavement down to the upper surface of the foundation. Then if needed, build up the foundation with a bituminous base of at least three inches, laid as already described. But when there is not room for this, then lay a dense binder of not less than one nor more than three inches thickness. The bituminous pavement wearing surface is then laid upon the foundation, built up in one of the two ways just described.

If the old pavement is of brick, cobble or stone block and at the same time sufficiently low to permit being surfaced with bituminous pavement, these old pavements can be used for a foundation by having the blocks and the joints between them well cleaned. A binder, such as I have described, is then laid over the old pavements, to a sufficient height to leave two inches for the wearing surface.

If the old pavement is a macadam at a height, thickness and quality suitable for a foundation, it can be brushed clean, built up to the grade desired with clean crushed stone, and that new surface be first rolled with a very heavy steam roller and finished by being coated with a suitable bituminous cement. The old macadam thus becomes a bituminous base.

The foregoing briefly describes the best methods in general, successful use, for preparing foundations for bituminous pavements. There are others, some very complex and expensive with no advantages over any of those described. There are still others which are positively bad in principle and worse in practice; for example, coating the surface of a hydraulic cement concrete foundation with a bitumen or bituminous cement.. This has been tried and is a positive detriment; among other reasons because the bitumen can not run down into, but gathers in large and small pools on the concrete. It soaks upwards and softens many spots of the wearing surface, causing the pavement to wear unevenly as well as to slip on the bitumen softened below by the heat of summer. The surface of a hydraulic cement concrete should never be coated with bitumen, whether with asphalt or other bituminous cement. It can not be spread evenly, and is a useless expense. The concrete foundation can be made strong and with a rough surface by the method of thoroughly tamping I first described under this portion of our subject.

Wearing Surface. The upper layer, about two inches thick, being subjected to the direct wear of traffic and weather, is called the wearing surface. Let us consider some of the essential principles needed for the construction of successful bituminous pavements containing crushed stone.

A brief glance backwards shows how new this general kind or type of pavement is. Although there had been earlier attempts in England and France, it was not until about 1880 that a small amount of roadway was surfaced with definite experimental mixtures of crushed stone, pitch and tar. This was in Europe as well as the later experiments of mixing crushed stone with rock asphalt in Germany and France, with the hope of making the asphalt pavement less slippery.

Several attempts were made in America of laying mixtures of stone and gravel with tar or asphalt. They were nicknamed poultice pavements and failed. About 1899 the late F. J. Warren began to investigate compounds of stone and bitumen, to learn the causes of previous failures and how to succeed. He made a distinct advance in this art and, what is known as the bitulithic pavement is the result of his researches. He invented some new machinery, process and mixtures, and insisted upon certain qualities of the crushed stone and bituminous cements used. Therefore, the pavement laid under his formula is thus far the best one of the general group of crushed stone bituminous pavements.

By whatever process produced, a bituminous crushed stone pavement, to be successful, must meet the following requirements: It must have maximum density with minimum voids; the stone used must be durable to resist wear; the crushed stone so proportioned in a de-

scending scale as to have each successive smaller size fill the voids between the larger sizes down to the finest powder, and have these stones mutually support each other; then a cement must be used which is water proof, adhesive and ductile, not only to cement the mineral aggregate together, but also to fill any possible tiny voids; this is best accomplished by pre-separating the crushed stone into several sizes and storing them in several bins, then taking such proportions of each size from each bin as have been found by technical tests to give a mixture of the greatest possible density of the kind of stone used, or a density as near as possible to that of the original stone from which the crushed stone was made. The result is easily demonstrated by comparing the specific gravity of the stone before it is crushed with the final aggregate of crushed stone. It is not possible to obtain a maximum density by using crushed stone direct from a crusher, or by filling its voids with some small sizes which are not graded, nor by filling the voids with a mixture of sand and stone dust. Comparisons of the different weights of say one cubic foot, of each of these mixtures show at once the lack of weight and consequent lack of density of all mixtures which are not made on the principle of assembling the crushed stone in graded sizes from the largest to smallest particles. I have examined bituminous stone pavements of several kinds in many cities, some using mixtures on the principle I first described, and others on the other methods I have referred to, and found the above facts to be borne out in practice.

Without going into technical details of the bituminous cements used I can suggest some of its requirements. It must be uniform as shown by penetration, flow, evaporation and other tests. It must be soft and viscous as possible and still have adhesion and strength sufficient to bind the mineral aggregate together at all weather temperatures, and when subjected to the shocks of wheels and hoofs. It must not be volatile at the temperatures used in mixing, which, of course, cover weather temperatures. It must resist water action and be ductile and flexible as well as remain adhesive at the extremes of winter and summer.

A crushed stone bituminous pavement, when finished, should have a granular rough surface, so as not to be slippery for people or horses, and to prevent the skidding or sliding of vehicles sidewise. This is very much appreciated by owners of automobiles. It will have this surface when composed of as much angular crushed stone as possible, compressed together.

A special surface finish is applied to the best pavements of the type we are considering. It consists in applying a thin film of a suitable, soft, quick drying bitumen, applied hot, and then spreading on it a thin layer of very fine stone grit. The function of this process is to seal any pores which may exist on the wearing surface, and still leave the surface roughened.

I will close by briefly stating what must not be done and what I have observed produces weak crushed stone bituminous pavements, which do not give maximum service for minimum cost of construction and minimum subsequent maintenance.

Stone, as I have indicated, as it comes from the crusher is called "crusher run" stone. This is not suitable for making the densest compounds. The different sizes of the crusher run stone are not in the right proportions to reduce the voids to a minimum; nor is such crushed stone constantly uniform in its composition of sizes or arrangement of sizes, even from the same quarry. The use of crusher run stone is one of the causes of failures of the pitch and tar macadams of the past which were laid for experimental or other reasons, and are still laid to a limited extent in a few small places.

A very few attempts have been made to construct a pavement of the general type we are considering, by combining crushed stone containing say 30 per cent or even 20 per cent of voids, with a bituminous mastic or an asphalt paving mixture of sand, dust and asphalt and other bituminous cement; relying upon this bituminous mastic or mortar to fill these voids in the crushed stone. Such pavements might be called asphalt filled stone or stone filled asphalt pavements. They have not the best qualities of either. Their greatest defect is that the stone ingredients do not interlock and mutually support each other, but, are kept apart by, or are suspended in the yielding bituminous mastic or mortar.

A somewhat similar process was tried in Germany and France and is now being tried to a limited extent on a few roads, outside of cities. The process I refer to is the use of crushed and ground natural bituminous rock, called rock asphalt, as filler or binder for ordinary macadam. This has not been found economical in Europe, but it may meet with better success under light traffic on country roads where it can be obtained cheaply near the quarries of rock asphalt.

There are other processes which are impracticable in theory and practice, although they are sometimes described in the technical press, and by men who would like to get them tried at public

expense. They generally advocate using quarry run crushed stone, mixed with sand and bituminous cement, or with semi-liquid bituminous mortar and then relying upon tamping and rolling to produce a pavement having its voids filled from pressing the mastic or mortar into voids. Such pavements would not be dense nor durable. Such pavements contain some, but not sufficient stone, nor the right proportions of all their ingredients. They produce cellular pavements, with the cells filed with weak, pliable material. They violate the standard engineering principle that wearing surfaces, subject to combined shock, rolling and other friction, must not have irregular densities. A successful bituminous pavement of the crushed stone type must have all the stone possible concentrated in it, so as to present a maximum resistance to wear. The bituminous cement used must not only be of the right quality, but must be used only in sufficient quantity to cement the mineral aggregate together and make the pavement weather proof.

STREET CLEANING AND DISPOSITION OF SWEEPINGS.*

By T. Chalkley Hatton, Consulting Engineer, Wilmington, Del.

It might be well to outline briefly what the writer learned from the replies received to a circular letter, sent to the mayors of the cities of the United States, east of the Mississippi, having a population of over 20,000.

Of the 210 cities, 81 cleaned by hand alone by day labor, employed under the direction of the street commissioner or a deputy, 115 cleaned by both hand and machines by day labor, 9 cleaned by machine and hand by contract, 1 cleaned by hand and machine by prisoners, 1 of over 45,000 population cleaned by private subscription only, and then at irregular intervals.

In 133 cities the sweepings were used for filling in low places on outlying streets and private grounds. In 49 cities the sweepings were used as a fertilizer. Of the 115 cities cleaned by both hand and machine by day labor, 72 used the hand labor exclusively by day, by which all paved streets in the business districts were cleaned once a day at least. The residence streets which were paved were cleaned from once a day to three times per week, the machines being used by night only. In 57 cities the two-wheel hand vehicle was used to retain the sweepings temporarily as they are swept up by hand, this vehicle having either a bag or metal barrel, the bag, when full, to be tied up and deposited upon the curb line, to be removed by the horse wagon following the sweeper. In 37 cities the sweepings as they were gathered by the "white wings" were deposited in the nearest manure pit, and in 20 carts followed the "white wings," picking up the bags of sweepings left along the curb and leaving fresh bags for the sweepers. Of the 115 cities which cleaned by both hand and machine, by day labor, 96 sprinkled the streets ahead of the machines, the others apparently allowed the dust to fly. Eight cities cleaned their business sections after closing hours by flushing the streets from the fire hydrants and allowing all the dirt to wash into the sewers through the inlets.

There are several interesting points brought out in examining the results of these replies. One is that the majority of cities find that the street cleaning is best accomplished by day labor and not by contract. Another that machine sweeping is not popular if done during the day owing, no doubt, to the interference with travel and the dust which is thus bound to be raised. Again, that business streets are, in the main, cleaned once a day and residence streets, paved, are cleaned on an average of three times per week. Gutters in suburban districts are cleaned upon complaints of the property owners. As stated, there were 49 cities where the street sweepings were used as fertilizer, and from the writer's personal knowledge of these cities, they are surrounded by the most fertile lands with the most prosperous agricultural communities, from which the writer naturally concluded that these communities have been indirectly enriched by using good sense, and that it will be largely beneficial to any municipality to carefully gather up its street dirt, which is largely composed of manure, and deposit it upon piles or beds in different sections of the suburban districts, making a compost of it, and then permitting the farmers and truckers to remove this compost to the surrounding lands.

The cost of sweeping the streets is

*Extracts from a paper before the American Society of Municipal Improvements.

known to but few of the officers of the cities who answered the writer's questions. In fact, there were but 22 cities where the officers in charge could tell how much per mile it was costing to sweep the streets, and of these only 13 could tell the relative cost of cleaning by hand and machine, and yet there was expended for this purpose in 1905 millions of dollars, all for surface work of such a character that a good clerk, working on an average of two hours per week for 52 weeks, at a total cost of say $50, could have determined what the unit cost of street cleaning was in the average city.

The answer to the question, "How does the cost of machine cleaning compare with the cost of cleaning by hand?" was "The machine is far cheaper," except from those 13 cities where accurate records were kept, and which showed beyond a doubt that the hand cleaning was by far the cheaper process. The writer some weeks ago called upon the street commissioner of a city of 90,000 population and asked him the above question, and the reply was as usual—machine cleaning about one-third the cost, but no accurate records had been kept, although both processes were in use. We went together upon the streets to view the work being done, and incidentally the cost, with the following result: One "white wing" had a district comprising the leading business street of the city, upon which two car lines were maintained. The street was paved with bricks, asphalt, bituminous macadam and granite blocks. The district cleaned by this one man was 2,700 feet long by 40 feet wide, and he got over it entirely once a day for every working day in the year, except when it snowed or rained. His wages were $9.00 per week. The sweepings were dumped by him in the nearest stable manure pit, which in some cases was two blocks away. We found by this method that this street was being cleaned for $1.25 per 10,000 square yards. Upon an adjoining residence street, paved with bricks, the machine gang was then at work, and consisted of one two-horse sweeper, one two-horse sprinkler, six one-horse carts, one foreman and 11 men. Double teams cost 50 cents an hour, single teams 31 1-4 cents, foreman and six men 20 cents, 5 men 17 1-4 cents, the sweepings were being hauled 5,700 feet average haul, and dumped upon low ground. This gang cleaned at the rate of 3,305 square yards an hour, and at that rate the cost was $15.00 per 10,000 square yards, or over ten times the cost of sweeping by hand.

The result of the writer's investigation has shown that the cost of sweeping streets by machine averages $7.53 per 10,000 square yards; by hand, $2.45 per 10,000 square yards, and flushing streets, about $3.18 per 10,000 square yards; that the cost per capita per annum for cleaning streets in the cities east of the Mississippi was in 1904 and 1905, 53 cents, and that the cost in those cities which kept their streets well cleaned was 75 cents per capita per annum, the last named sum being a very reasonable one when it is considered what it secures.

The writer is of the opinion that the best results, both as to quality and economy, can be secured by cleaning paved streets by a well organized and efficient force of "white wings," by which the sweepings are collected and deposited in bags upon the curb lines, to be picked up by carts which haul these sweepings to a compost dump, located as near as possible to the district cleaned, when, after adding some hypophosphate, the farmer is invited to come nad haul it away. He believes that the cleaning should be done so frequently that no organic matters should be allowed to remain upon the surface of any streets for more than 12 hours, and in the business streets, where the travel is heavy, the cleaning should be done constantly by "white wings" having but 2,500 square yards of surface to cover per day per man.

After the business of the day is over a gang of men should flush the surface of every business street by means of hose attached to fire hydrants, and thus dislodge the fine dust left upon the surface by the hand broom. In the morning the street thus flushed presents a cleaned appearance, and it is free from those harmful dust compounds which induce catarrh and other throat troubles. This process, properly administered, is within the means of any city, large or small, the smaller the city the easier the process becomes. The cleanest kept city in the United States today is Washington, and it has the largest area per capita. The next cleanest kept city is Greater New York, where the obstacles for maintaining clean streets are far greater than in any other city of the United States. What can be secured in either of these two cities can be secured elsewhere if the "powers that be" can simply get the proper "point of view."

As an adjunct to the street cleaning process, all laws should be passed and observed, for preventing the unnecessary littering of the streets, and towards this end the city should erect and maintain proper receptacles upon the street corners for holding waste papers carried by pedestrians and for fruit peelings or other things thrown away by those who use

the public streets, and no business house should be permitted to sweep the dirt from its building upon the streets. Instruct your police force that these laws must be rigidly enforced, then note how proud you will be at the end of a year that you are a part of such a community.

The collection of ashes and solid household waste is another duty devolving upon the community which has caused many anxious moments to the conscientious city officer.

In considering this question the writer excludes the collection and disposal of garbage which he considers outside the limits of this paper.

Of the 210 cities heard from, in 33 the collection of ashes and other household wastes was done by the individual property owners or occupants, in 74 the collection was a public duty, but let out by contract at a lump sum per annum. In 13 the work was done by contract at a certain fixed price per load of specific volume, and in 92 the collection was made by teams owned by the city, the labor being performed by force account. In some of the latter cities the wagons only were owned by the city, the horses and drivers being hired by the hour or day.

Thus it would seem that the large majority have reached the conclusion that the removal of waste household matters is a public duty.

Where the work is done by contract, the general opinion is that it can thus be performed much cheaper, but the writer questions this, considering, of course, that the same efficiency is maintained. In cities of 20,000 population or over, a regularly organized force of men and teams can be constantly employed during the winter months upon this work, so that no time need be lost if the city is properly divided into districts, and it becomes the duty of the force to cover each specific district in a certain unit of time fixed by ordinance. During the summer months the force can be reduced to such size as may be ample to cover the city which has been divided into larger districts.

With six exceptions all the cities heard from dispose of their ashes and solid household wastes by dumping them upon low ground or for filling in streets in suburban districts. In six cities these materials are sorted over by either independent persons or laborers employed by the cities, and all matters having any value are collected and sold, the residue either being taken to sea and dumped or used for filling in low ground.

The custom of dumping the ashes upon the low suburban streets of a city may be a necessary one, but it is certainly a nuisance to many residents who may be so unfortunate as to be compelled to live in the proximity of these ash dumps. Their houses are constantly filled with ash dust, and their nostrils with noxious odors, neither of which would be long suffered if these residents happened to be influential members of the community.

There are hosts of things in the average household wastes of a city which are valuable. For instance, the privilege of sorting the ashes and rubbish from the city of New York was in 1896 sold by the city for $140,000. Later the city retained the privilege and provided modern methods for separating the valuable matter from the rubbish, and realized a far greater profit from this source.

Probably the best system of collection of ashes and rubbish is that which is in use by the city of Buffalo. It certainly minimizes the objectionable things connected with such collection. The collection is done by contract, the collection being made once per week, from November to May, and twice per week the balance of the year. The more frequent collections in the summer months are due to the fact that the garbage is collected under the contract and by the same force. The householder is required to provide three separate receptacles, one for ashes, another for rubbish and a third for garbage. Any not so separated is not removed. There are three classes of wagons used, one for ashes, another for rubbish and the third for garbage. There are three separate gangs of men employed in each force. One goes ahead of the wagons, carries the receptacles from the premises, and sets them upon the sidewalk near the curb, the next gang dumps the materials into the wagons and the third gang follows immediately and returns the receptacles to their places upon the premises. The cost of this is 31 cents per cubic yard, or $60,000 per annum, or 17 cents per capita. By this method the ashes are so entirely separated from all that is valuable that they can be disposed of without additional expense. The rubbish can be easily picked over and the valuable parts separated, whereas the garbage is hauled directly to the reduction plant. The householder is not required to get his clothes soiled and his religion warped by rolling a barrel or box of ashes out of the yard, down the steps to the sidewalk, and carrying the empties back when he returns home at night. The appearance of the streets is not spoiled all day by unsightly barrels and boxes standing upon the sidewalks, where they are frequently upset by malicious boys, and the atmosphere of the

neighborhood is not polluted with decaying garbage.

The average cost of collecting ashes, solid household wastes and garbage is 26 cents per capita per annum, which includes the disposal of the ashes and wastes, but not the disposal of the garbage. The writer could not well determine the average cost of collecting the ashes and wastes alone, as in the majority of the cities heard from the three materials were collected by the same force, or under the same contract, but from such information as he was able to get the indications are that the average cost is 17 cents per capita per annum.

MUNICIPAL CONTROL OF PLANTING AND CARE OF SHADE TREES.

By William Solotaroff, Sec'y Shade Tree Commission, Orange, N. J.

There are two ways by which the work of planting and caring for shade trees can be accomplished. The work must be done either by individual land owners or public officials. The prevailing policy of most of our cities has been to leave this task to the individuals who own the property. The results thus obtained have been very unsatisfactory. There are no two people governed by the same taste in the choice of trees for planting, and as a result we usually find more than half a dozen different kinds of trees on the same street, undesirable species mixed with desirable, set either too close or too far apart and left unprotected from injury. In one case the trees will not be trimmed at all and the limbs will be so low as to touch the head of the pedestrian; the neighbors' trees on the other hand will be pruned too high. A concrete example of the conditions as to shade trees on a street in East Orange, N. J., will illustrate the results accomplished by individual planting.

There are forty-five trees on this street. Of these there are seven white maples, seven horse chestnuts, eleven red maples, two American elms, eleven Norway maples, one ash-leaved maple, two poplars and one linden. The trees range in size from two inches to thirty inches in diameter, and their distances on the street vary from 18 feet to 282 feet apart. Twenty-nine of these trees are rated good, seven are medium and nine are bad. Now what beauty can a street possess on which there are nine species of trees in all sorts of conditions, and widely varying in shape and size. The street described above is not an exceptional one, but is rather typical of the streets where private planting has been the rule; and familiarity with the condition of the shade trees in many of the cities of the state of New Jersey makes it safe to say that what is true of one state will be true of another, and that the results accomplished by individual planting have been very unsatisfactory.

When there comes a time that a certain insect pest is to be combatted and the work is then left to the individual citizen to do, he is completely powerless to accomplish anything. He may plant an undesirable species of tree if the task is left to him, but in insect fighting he will do even less. His efforts will come to naught if his neighbor allows the pest to remain on the trees. In the extermination of insects in a city, it is absolutely necessary that all the infected trees be treated in order to obtain effective results. The insects spread very rapidly; in fact, it is even difficult for a city that has an organized system and apparatus for spraying trees to keep the trees entirely free after treatment if the neighboring cities do not check the spread of the pests. It is impossible to have concerted action on the part of thousands of people of a community in the treatment of infested trees at the same time. Insect fighting requires persistence and a knowledge of what to do at the proper time to obtain results. There is a period in the life history of every one of our tree pests when it may be most easily destroyed. This stage is not always at the time when the most injury is apparent, or when the average citizen wakes up to the necessity of doing something. The life history of the pests must be known in order that treatment may be given at the right time. The injury to trees by borers is a case in point. The foliage does not show the effects of the damage done, nor do the limbs begin to die until three or four years after the caterpillars of the borers did their fatal work. Then the people wonder why the trees are dying. Hundreds of fine sugar maples are dying every year in the northern section of the state of New Jersey as a result of the ravages of the borers a few years ago. Attention to them at the time the insects were active would have saved the trees.

How little a citizen can do is shown by the condition of the private grounds and orchards in any city, even where there are organized bodies to take care

of the shade trees. On almost all the trees on private land are found borers, aphids or plant lice, and a great abundance of scale and sucking insects. They remain and propagate from year to year, and if one man by persistent work succeeds in ridding his place of the pest one year, the next year his garden will be as bad again by the migration of insects from his neighbor's grounds.

We can not blame the individual for these unsatisfactory results. We are seeking, in regard to shade trees at least, that which is for the common good of all, and we expect the work to be done by the citizens without instruction, without system, and leave to each one, if it so pleases him, to do his share when and how he pleases. It is the system that is wrong, and the remedy can readily suggest itself. Other municipal interests are vested in commissions, committees, or other organized bodies. It is felt that the matter of planting and caring for shade trees should be entrusted to a similar body and a shade tree commission should be incorporated in every municipality.

The idea of placing shade trees under the control of an organized body is not new and the results accomplished in cities by such provision have been so satisfactory that it seems surprising the system of municipal control is not becoming more general. All the trees in Washington are cared for by the city and all planting is done by city authorities. The new charter of Greater New York placed the shade trees under the care of the park department. The work done by that department, especially in the boroughs of Brooklyn and Queens, has improved the condition of the trees very materially. The jurisdiction of the park department of New York extends only to the existing trees and there are certain ordinances governing the setting out of trees by individuals. It has not the power, however, of initiative in setting out new trees, either by a general appropriation or putting a lien on property the same as for any other improvement. The best solution, by far, of the problems of the planting and care of shade trees is provided by a law of the state of New Jersey, and as far as we know, it is the only law of its kind in any state in the Union.

An act of the laws of 1893 of the state of New Jersey provides for the establishing of commissions to take charge of the planting and care of shade trees on the highways of the municipalities of the state. These commissions are to be composed of three members, appointed for terms of three, four and five years, and are to serve without pay. It is optional with the governing body of any city whether this act shall have effect there. Newark, Passaic, East Orange and South Orange are among the places that have availed themselves of the privileges of this act. All matters pertaining to shade trees in these places have been placed in the hands of the respective commissions. All work is carried on in a systematic way, and all trees are planted, pruned, sprayed and removed under the commissioners' direction. As practically operated, the commissioners serve as an organization and they employ a professional man, who has full charge of the executive work. Wherein these commissions differ from other similar bodies is that they have the power of initiative in the matter of planting. They decide that a certain street is to be planted and determine on the species of tree. An advertisement of the intention to plant is inserted for two weeks in the public newspapers. After the work is done the commissioners meet and certify a list to the receiver of taxes on the annual tax bill and it is paid the same as any other legal lien. The cost of pruning, spraying, removing dead trees and repairing old ones is provided by a general appropriation.

A brief review of the work done in East Orange, N. J., during the two and a half years that the Shade Tree Commission has been in organization will give an idea what has been done in all the cities of the state where the tree commissions have been established. About 1,300 trees were planted. The species chosen were the Norway maple, the sugar maple, the European linden, the American linden, the pin oak and the Oriental plane. Only one species of tree was planted on a street. These were set out at unifrom distances apart and all trees were supplied with uniform wire guards. The advantages of such a system of planting can be readily seen. By selecting the proper species of tree for street use, hardy trees are taken of symmetrical habit, of well filled head, neither too open nor too compact. By placing the trees at proper distances apart, each tree is allowed to develop its characteristic beauty and when mature there is sufficient space between the outstretching limbs for the admission of light and the free circulation of air, so essential to health and comfort. Streets that have become famous for their beauitful shade trees, both in this country and abroad, are planted with one species of tree. This plan is followed in Washington and the fame of Flushing, Long Island, as a beautiful suburb is due to the fact that its fine streets are in the majority of cases planted with one variety. Setting out one species of tree on a street can be

done only when one man or one body is laying out the work. An organized body in planting a street treats it as a unit, and selects a tree that is best adapted for the width of street, condition of soil and nearness to the houses to the street. By placing guards around all trees when they are set out all injury from horse bites is prevented.

There are sixty-seven miles of streets in East Orange. The trees on about twenty-eight miles of these streets were pruned under the direction of the Shade Tree Commission. In this work, too, the street was treated as a unit. All trees were pruned to a uniform height, a height that would permit the unimpeded passage of vehicles and would allow all street lights to be seen at night. All scars were painted with coal tar to help in the healing of the wounds.

By far the most important work done by the Shade Tree Commission of East Orange was the successful combatting of the insect pests, among which were the tussock moth attacking the American elm, the horse-chestnut, the white maple and the lindens; the cottony maple scale attacking the white maple; the wooly maple scale attacking the sugar maple, and the elm leaf beetle attacking the elms. As far as was possible the idea constantly borne in mind was to fight the insects before they developed, and hence before great damage was done.

The placing of the control of shade trees in the hands of commissions is no longer a theory in the state of New Jersey. Those cities that have availed themselves of the privileges of the state act and have organized the commissions are enjoying the benefits of the work of these bodies and other cities are taking up the matter. Considered solely from an economical standpoint this system of municipal control should commend itself to all interested in city improvements. A body planting several hundred trees at one time is able to select good nursery stock, get the trees at wholesale prices and accomplish work which the individual could not do at perhaps twice the price. The result is that there is no opposition on the part of the citizens to the improvements which the commissions in the several cities of New Jersey are making. The advantages of their methods are seen and assessments for newly planted trees are paid as readily as for any other improvements. The desirability of having shade trees, especially on residence streets, is now universally recognized. From all large cities people are flocking to the suburbs; and the desire to make these places as countrylike as possible is very great. Real estate people are aware that beautiful trees will increase the value of their property. Either through ignorance, however, or more likely through the desire for immediate effect, real estate people build houses to sell, they are planting the Carolina poplar and the soft maple to the exclusion of every good tree. Any one familiar with the new sections on Long Island, in the boroughs of Brooklyn and Queens, developed by real estate firms, will understand what is meant. The Carolina poplar is the predominating species of tree planted. In a few years these trees will detract from rather than add to the beauty of the places. As in the setting out of trees the future rather than the present is to be considered, the importance of the question of shade trees in new cities is just as great as in those having old trees; and a body to take charge of trees should be established in every city as soon as the streets are opened and provisions are made for any of the other city improvements.

PUBLIC WORKS IN LOS ANGELES, CAL.*

By T. D. Allin, City Engineer, Pasadena, Cal.

Los Angeles is a city of remarkable growth, its population having increased fully 35,000 during the past year with a growth close to 100,000 during the past three years.

The water plant is owned by the city but electric lights and gas are supplied by private companies.

The greatest municipal undertaking for the year has been the decision to go to the Owens river in Inyo County, California, for an additional water supply.

The conduit for conducting the water to the city will be approximately 250 miles in length and will cost approximately $27,000,000, which, together with impounding reservoirs at the headwaters of the Owens river and other expenses will bring the final cost to approximately $32,000,000.

Such a bold undertaking had never before been entered upon for a public water supply by a city of the size of Los Angeles, but the water was necessary and could not be had in adequate quantity at nearer points and at a less expense. The

*Extract from a paper before the American Society of Municipal Improvements.

people quickly recognized the undertaking as a necessity and entered upon it with the same cool, deliberate enthusiasm that they would enter upon any other business undertaking which they believed would repay them many fold upon the investment.

In the first bond election for $1,500,000 for the purpose of acquiring water rights and beginning the work, the vote was 14 to 1 in favor of the bonds, which clearly showed the united determination of the people to provide an abundant water supply for the city of Los Angeles.

Both preliminary and location surveys are now being made for the conduit, which will probably be of reinforced concrete, about 12 feet wide at the bottom and 28 feet wide at the top, from 8 to 10 feet in depth and covered.

Twenty-five thousand miners inches are available, which is equivalent to 325,000,000 gallons per day, and is eight and one-half times the quantity of water now being used by the city. The conduit will be a gravity line throughout, over valleys and desert and through mountains, with an opportunity to develop fully 80,000 horse power along its line.

During the year ending Nov. 30, 1905, the city laid 41.23 miles of pipe varying from 4 to 24 inches in diameter, made 6,608 service taps and added 5,347 meters. At that date there was a total of 46,160 service taps and 8,832 meters.

At the present date some 13,000 meters are in service.

Without meters the city was using 300 gallons per capita, but when 8,832 meters had been installed its per capita was reduced to 190 gallons.

No doubt the most interesting and important water case ever tried in the arid west, was the case carried on during the past year by the city against the San Fernando ranchers. The Los Angeles river from which the city has taken its water from the city's very beginning, has its origin from the seepage through the valley gravels along the lower rim of the San Fernando Valley. Until a few years ago, the valley was used almost exclusively for grain raising. But few wells were in the valley and the water from these few wells was used only for domestic purposes at the few ranch headquarters scattered over the valley.

A few years ago, on account of the growth of Los Angeles, the lands nearest the city became valuable for truck farming and for the raising of alfalfa, crops requiring a large quantity of water for irrigation.

The ranchers, believing that they were the owners of any water that they could obtain from wells on their own lands, sank wells and put in pumping plants. As the number of wells and the quantity of water taken therefrom increased, the city's supply began to decrease proportionately with the quantity of water taken from the wells.

It was soon realized by the city that, with a rapidly increasing population, its principal water supply, made use of for more than 100 years, was rapidly decreasing, and unless its use in the San Fernando Valley could be controlled, the city river supply would soon be depleted.

A year ago there were practically 500 wells in the valley with new wells and pumping plants rapidly increasing in number, from some of which, when in use, more than 100 miners inches of water was being taken. From all indications, unless prevented, a few more years would see thousands of wells in the valley and the water plane lowered below the channel of the Los Angeles River.

The city brought suit to prevent the ranchers from taking water from the wells for irrigating purposes. The case was bitterly contested by both sides with the best attorneys and engineers on the Pacific coast taking part. The city won the case in the Superior Court, but the case is now in the higher court.

Storm Sewers. The city is just completing 12 miles of storm sewers varying in size from nine inches to seven feet. The smaller sewers are of vitrified pipe, but the larger diameters are of either brick or cement concrete. Both brick and concrete sewers are lined on the flow quadrant with vitrified brick. A bond issue of one-half million dollars has been expended, and another expenditure of a larger amount is badly needed for like purposes.

Sanitary Sewers. The city is now constructing an outfall sewer to the ocean which is only about 60 per cent. completed. Much delay and annoyance is being caused by bad ground and rebellious contractors. The contractors have thrown up the job and the city is now advertising for bids to complete the work, which completion will require about one year.

The old outfall to the ocean is entirely inadequate for the city's needs, and until the new outfall is completed the city can not push the construction of city sewers, which are badly needed.

It is the writer's belief that no sewage should be wasted in the arid west where water is so valuable. A safety valve to a steam boiler is necessary but every pound of steam allowed to escape through the valve is a waste. Just so with the Los Angeles outfall sewer to the ocean. It is a safety valve, but every gallon

of sewage passing through it to the ocean is a waste of the city's most valuable asset. A part of the sewage is now used for irrigation, and as plants for sewage purification become more fully perfected, no doubt a very large part and perhaps all of the Los Angeles sewage will be used for irrigation on the arid lands between the city and the sea.

Garbage Disposal. The city erected during the past year a garbage destructor which a few months after construction was partly destroyed by fire. It has been rebuilt and is again in use. The garbage is collected twice weekly in the residence district and daily in the business section, the property owners being required to furnish their own recepticles.

General Improvements. Large sums are being expended for bridges, park improvements, new fire buildings and equipments and for city schools. Library quarters are inadequate and a new building will be built in the near future.

STREET RAILWAY SITUATION OF DETROIT.

By Robert K. Davis, Detroit, Mich.

The controversy between the municipality of Detroit and the street railway company began in 1891 in connection with a strike on the part of the operatives of the railway system for higher wages. During that industrial dispute, considerable bitterness was engendered between the citizens and the owners of the street railway lines, which were then operated by animal power. The discussion waxed warm and continued after the settlement of the industrial dispute. Upon the one side, the late Governor Pingree, of Michigan, then the mayor of the city, made the contention that the franchises of the street railway company had already expired, his view being that the grant made in 1879, and extending the life of all street railway franchises in the city, was defective. An issue was framed upon this point and carried through the state and federal courts, with the result that the court of last resort decided that the grant made in 1879 was not defective, as claimed, but continued during the full period until 1909. The difference between the street railway company and the city has been, since that time, made the subject matter of discussion—some of it intelligent and honest, and some of it selfish and political—between the people of the city and the company, with the result that as the years have elapsed, the city and the company are now facing the prospect of the expiration of certain franchises in 1909.

The contention of Mayor Pingree and his associates was that the street railway company was charging too great a rate of fare, and he and they set themselves out to procure for the people and the city a three-cent fare, which was afterwards modified to the proposition of eight tickets for a quarter.

Failing in securing access to the streets upon which the franchise had been extended for thirty years from 1879, and thereby making new conditions with the street railway company, which would result in something permitting the adoption of the eight-for-a-quarter rate, a number of moves were made with various sets of capitalists, having for their object the purchase of the street railway properties by new capital, which would grant, in one form or another, the much desired reduced rates of fare. These efforts all failed of their object, although, at various times, each of them seemed upon the eve of completion.

The city of Detroit is peculiarly laid out for the purpose of street railway transportation. Modeled originally upon the design of the city of Washington, the system of radial streets provided in the plan of the national capital by L'Enfant, the French engineer, was put into the plan of the city after the destructive fire of 1805, the result being that from the center of the city main avenues radiate in all directions, thereby giving ready and direct access to the various sections of the city.

Imposed upon this radial system is the ordinary rectangular system of streets and avenues which is familiar in the planning of most American cities.

These radial streets were all occupied by the original street railway company, and under the franchises existing at the time of the beginning of the Pingree agitation, a single fare was charged upon the lines running upon these streets and having their termini the center of the city, so that to cross the city from east to west or from west to east required the use of two lines and the payment of two fares.

A modification of these franchise privilges was made voluntarily by the street railway company upon the introduction of the electric system of transportation

to the extent that lines terminating in the center of the city were consolidated in their operation and made into fewer routes crossing the city from east to west, a single fare being required from one point to any other point upon these routes. Certain transfer privileges were conceded voluntarily, but these concessions were not sufficient to satisfy the demands of the public at the time.

In 1895, Messrs. Everett and Moore, who have since become famous as large operators in street railway properties, appeared upon the scene in Detroit and procured a franchise from the city, covering some sixty miles of streets, and proceeded forthwith to construct a street railway system.

From the nature of the situation, the routes thus authorized could not be direct, but were obliged to follow the streets forming the rectangular blocks and squares rather than the radial streets, which furnished the most direct routes to the center of the city, these latter being already occupied by the first street railway system. However, a system was built which developed certain portions of the city not then ejoying street railway facilities, and was put into operation upon the basis of an eight-for-a-aquarter rate during the hours of the day and up to 8 o'clock at night, and six for a quarter from 8 o'clock at night until 5 o'clock in the morning, and a single 5-cent cash fare. Opposed to these rates was a straight 5-cent cash fare upon the lines of the already existing companies, modified by an eight-for-a-quarter workingmen's ticket, available during two hours of the day, one in the morning and one in the evening.

The new corporation continued to give service independently for about four years, after which time it was absorbed into the Detroit United Railway, a new corporation composed of the owners of both the old and the new systems, and the two came to be operated under a single management and with such economies as grew out of consolidation of the expense of superintendence and the production of power; but so far as the eight-for-a-quarter system and the oriignal lines were concerned, they were continued to be operated as separate properties, with a separate rate of fare.

Detroit has 187 miles of railroad within its present city limits. Of these, 60 miles are operated under the eight-for-a-quarter system and the remainder under the 5-cent fare basis.

The public duties of the original roads included the payment of an annual tax of 2 per cent. upon their gross receipts, the ordinary taxes upon their real estate for city purposes and the taxes which included the assessment of a large valuation representing franchises for state purposes. In addition, these railways are required to make the foundations and maintain the pavements between their tracks, but no portion of the pavement outside of the rails. The eight-for-a-quarter system is required to pay no tax upon its gross receipts, and in consideration of the undertaking of its projectors to furnish cheap railway fare to the city of Detroit, it was relieved of the duty of providing foundations and laying and maintaining pavements between its tracks. This contribution toward the operation of the cheap fare lines represented relief from the 2 per cent. franchise tax upon about $800,000 of earnings per year, and from paving obligations which the commissioner of public works has lately estimated to average $60,000 per year.

As between the eight-for-a-quarter system and the 5-cent system, no provision is made for transfers for the benefit of patrons who desire to move from a point upon one system to a point upon the other.

The present condition of the street railway question in Detroit is, therefore, briefly as follows:

The two distinct fare systems exist, and there is no accommodation afforded between these two systems except to such passengers as pay a straight 5 cent fare, and this accommodation is not a matter of right to all patrons, but of concession by the owners of the properties.

That two distinct sets of provisions exist regarding the public duties of portions of the systems with regard to taxes and the maintenance of ways.

That as to the eight-for-a-quarter system, franchises in effect at the present time will continue to apply to the lines of this system until December 4, 1924.

That as to the 5-cent system, certain of the franchises, being downtown portions, will begin to expire in 1909, but not with such completeness that it will be possible to use them as the basis of the new system, beginning in the center of the city and extending to its outside districts. For instance; certain accommodation made to the eight-for-a-quarter railways when they were being constructed, to avoid duplication of tracks in the downtown district, resulted in the occupancy by them of certain stretches of tracks, the franchises for which would have expired in 1909 had there been no interference, but which are now held to be extended to the full life of the Detroit Railway or eight-for-a-quarter system's ordinance.

Several mayors of the city of Detroit

have applied their genius to the settlement of this question. There has been considerable bitterness engendered in the discussions. Meantime, the present owners of the property have gone ahead, have practically rebuilt the entire system, refurnished it with equipment and maintained an excellent service. Even the most violent opponent of the street railway management will do it the grace to concede that the service rendered to the people of the city of Detroit is adequate and excellent. We who live in that city like to flatter ourselves that in quality and condition of track, in quality and capacity of cars, in frequent service, and the speed with which the cars are moved, the street railways system in our city is just a little better than that in any other city in the United States. The present managers of the property have not been ungenerous in putting back into it a large portion of its income for its development and maintenance. Within ten years, the city has added upwards of 100,000 people to its population. Owing to the friction existing between the railway company and the city government there has been, in that period, but two miles of additional railway route added to the facilities which existed ten years ago.

With the departure of Mayor Pingree from the office of mayor, and his assumption of that of governor, he was succeeded by the Hon. Wm. C. Maybury, who held office for a period of seven years, and whose policy, while not wavering in the expression of the city's opposition to the railway company's claims, was one that was calculated to bring about peace rather than engender bitterness between the railway company and its patrons.

Mr. Maybury was succeeded a year and a half ago by the present incumbent of the Mayor's office in Detroit, the Hon. Geo. P. Codd, who, immediately upon his assumption of office, proceeded to bring about, if possible, a permanent and lasting peace between the people of the city and the street railway company, serving them upon conditions which would be fair to the people of the city of Detroit, and at the same time, not unjust to the capital invested in the street railway system.

A series of conferences, covering nearly a year, has recently resulted in the proposal by the Mayor to the people of a new franchise, the terms of which have been the subject matter of negotiation between himself and the representatives of the street railway company, and are said by both to represent a final solution of the street railway question in Detroit, when it is considered that a fair return is to be provided for the capital actually required to reproduce the system and to maintain the present scale of wages paid to operatives. This latter, by the way, is the highest rate of wages paid upon any surface line in the United States, being twenty-five cents per hour for both motormen and conductors who have been in the employ of the railway company for more than three years—this group of operatives representing fully 80 per cent of the employees of the system.

The terms of the new ordinance proposed by the Mayor of Detroit and accepted by the railway company, are that all of the franchises of the various lines, some of which expire in 1909, some others in 1902, some others in 1915 and some others between that date and 1924, shall all be extended to the date upon which the franchise rights of the Detroit Railway, or eight-for-a-quarter system, will expire under the terms of its ordinance, viz.: December 4th, 1924, and that in consideration of the continued permission to do business, the raiway company shall accept the following conditions of operation: That for five hours of each day, viz.: from five until eight o'clock in the morning, and from half past four until half past six in the afternoon, an industrial ticket fare shall be placed in operation at the rate of 10 tickets for 25 cents, or two and one-half cents per industrial ticket. That during the remaining hours of the day, a six for a quarter ticket shall be accepted for fare. The single cash fare rate of 5 cents, which seems to be standard upon all street railways of the country, remains. These fares are to apply to all the lines, and a system of universal transfers from line to line shall be put into operation and maintained. Upon the gross receipts of the entire system, the street railway company shall be required to pay a tax of two per cent per annum into the city treasury as a franchise tax. As to public duties with regard to streets, the railway company shall be required to make and maintain foundations and pavements lying between its tracks and to maintain all pavements for 12 inches outside its tracks.

Furthermore, as the franchies will expire at a uniform date, viz.: December 4th, 1924, and as upon that date no municipal ownership proposition which might be suggested could be enforced as against the entire street railway system of the city, if that were at any time thought desirable, provisions have been made for the purchase by the city, at the expiration of the period of the franchises now granted, of the entire new system, upon an arbitration value to be determined by a commission, a portion of which shall be appointed by the street railway proprietors,

a portion by the city, and another portion by the local Chancery Court. The arbitrated value shall be the purchase price of the property, and in arriving at it, no account shall be taken of the value of franchises or of the good will of the business. The arbitrators will be required to determine, as between the city and the railway company, the value of the property then in existence and capable of being taken over by the city as a going concern.

It might be added that the new franchise provides for the immediate construction of 23 miles of additional track within the city of Detroit and for the construction from time to time hereafter, as the Common Council may direct, of additional routes, the rights to all of which, under the terms of the new ordinance, will expire at the same time as all of the rest of the property, thus enabling the city, at their expiration, to come into the possession of every yard of street railway track within the city, if such a process shall be deemed desirable.

Ample reservation of police power and of the right to regulate the operation of cars, to alter routes and to provide all manner of other reasonable regulations of the street railway system is reserved in the ordinance to the Common Council.

The whole proposition is now being discussed by the people of the city of Detroit. So far the ordinance has received the approval of the leading business men of the city, a distinguished body of citizens having associated themselves into a Citizen's Committee, which has already audited the books of the street railway company and determined for itself what the cost of carrying passengers in Detroit is and what it should be, and what capital investment would be necessary to reproduce the properties.

TESTS OF OTHER WOODS THAN YELLOW PINE FOR PAVEMENTS.

By F. A. Kummer, New York City.

The increase in the price of long leaf yellow pine since the year 1900 has been quite 50 per cent. I remember distinctly buying five and six years ago large orders of one million feet or more of all heart, long leaf, Georgia pine at considerably less than $20.00 per M. delivered at New York, while inferior grades of lumber today command a price of about $30.00 per M. It will readily be seen that a difference of $10.00 per M. feet adds 36 cents per square yard to the cost of 4-inch block. Wood pavement being already the most expensive pavement in the market—at least so far as first cost is concerned, this heavy increase naturally to some extent has limited the market for this character of pavement. Not only has this been true so far as price is concerned, but the quality of the lumber obtainable has also decreased. Five and six years ago the material which we purchased for paving block purposes was cut from the best part of the tree and was dense, solid lumber, usually cut from trees of fairly large size. The lumber we get today contains a small proportion of sap wood, which is undesirable, and is usually cut from the tops and smaller parts of the tree and from smaller trees; and for this and other reasons is less dense in quality and requires more care and expense in treatment to bring it up to the standard which is called for by the best specifications.

Appreciating these conditions, not only individual manufacturers of wood block, but the Bureau of Forestry of the Department of Agriculture have been conducting tests to determine what other woods of those available in this country can be successfully used for paving block purposes. The first test of this character of any size was arranged between three parties, viz.: The Department of Agriculture, The Kettle River Quarries Company of Minneapolis, who are manufacturers of wood block, and the City of Minneapolis. Without going into the exact details of this test, it has been arranged to lay a section of pavement in Minneapolis upon which the several kinds of wood are to be tested in comparison. Among these are Norway pine, which has been extensively used in that part of the country for street paving work, and tamarack, which has had a much less extensive use for this purpose, but promises excellent results. This test, which is to be made on a heavily traveled street, should show much, both as to the quality of these woods and the best methods of laying them—as in the test different forms of construction will be used.

Early this year the same arrangement was suggested by the Department of Agriculture, Bureau of Forestry, with the U. S. Wood Preserving Company and the City of New York, the purpose being to test against long leaf yellow pine not only short leaf pine, but tupelo, loblolly pine, maple, sap gum, scrub pine and scrub oak. This test was to be somewhat similar to that made in Minneapolis, although

embracing different varieties of wood and a different arrangement of the variables which could affect the construction; such for instance, as the question of laying blocks on sand cushion or mortar bed; the best form of joints to be used between them and whether the blocks give better results laid straight across the street or laid at an angle with the curb. The arrangements for this test have not yet been perfected, although this is not in any way the fault of the City of New York or the Department of Agriculture, but is due to delay on the part of the wood block company, who are not yet quite ready to undertake the experiment as proposed, pending other tests which are now being made. The writer has some doubts as to the value of tests on scrub oak, maple and some of the other woods named, as it is questionable whether they could be secured in large quantities, commercially, at reasonable prices—although in this respect there seems to be a conflict of opinion.

There is one wood, however, with which we have made extended experiments in New York City with very satisfactory results. This wood is what is known in the South as black gum. The source from which we are now obtaining it is Norfolk, Va., and vicinity, but it no doubt exists in other localities in large quantities. Unlike red gum, it has not been particularly valuable for any general use, owing to its very irregular and crooked grain and the difficulty of properly seasoning it. One city block between the tracks of the Metropolitan Street Railway Company on Hudson Street, New York, was laid with this pavement about a year ago. The joints between the blocks were filled with paving pitch. They were laid on a cement bed on concrete, as usual. They have given perfect satisfaction in every respect, have shown no tendency to swell and have worn, if anything, even better than the pine in the adjoining track. This wood, which is materially cheaper than pine and promises to remain so, possesses some advantages as a paving material and some disadvantages. Among its advantages may be named its extremely tough and close grain, making it not only a very durable block, but also one which does not split readily. This is an enormous advantage to the manufacturer, as waste in cutting, handling and shipping pine blocks is extremely large. Among its disadvantages may be named its greater weight in shipping, the greater length of time required to prepare it for treatment by driving off the contained moisture, and the fact that when this moisture is driven off the blocks require a greater amount of preservative per cubic foot to thoroughly impregnate them and fill up all the pores.

This wood is now allowed in the specifications of the boroughs of the Bronx, and Queens in the City of New York, as an alternate for pine, and the U. S. Wood Preserving Company has recently taken the contract to lay a street containing somewhat over sixty thousand square yards with this wood in the borough of the Bronx. Large shipments have also been made to Bridgeport, Conn., to Holyoke, Mass., to Springfield, Mass., for the main street there, and to Boston for the Boston Elevated Railway for track work on Beacon Street. Lexington Avenue, New York City, from 42nd to 72nd Streets between the tracks of the Metropolitan Street Railway Company has also just been paved with this material, and sixteen thousand square yards are now being shipped to Boston for street work. A contract has also been let to lay this wood on Green Street in Baltimore, Md. The specifications of the City of Cincinnati also permit the use of this wood as an alternative of pine, as do also those of a number of other places.

In any determination as to the value of a wood for paving purposes, if we start with the assumption that by filling the pores of the wood throughout the block completely with a good quality of creosote oil decay can be prevented, there remains only one other question to be decided and that is whether the wood is sufficiently dense, tough and hard to successfully resist heavy travel. Such a determination is not a very difficult matter. In fact, it is almost self-evident that, using Georgia pine as a standard, any block which is as hard or harder than this wood should give equally as good or better results, while those blocks which are not so hard—such for instance, as short leaf, loblolly and Norway pine should give less satisfactory results. The writer believes that all these woods can be used for paving purposes if properly treated, but should be used with discrimination. A street laid with loblolly pine under moderate travel might readily give a serviceable life of twenty years or more, while a similar pavement under the excessively heavy travel found on such streets as exists in the lower part of New York City would probably be destroyed very quickly. The length of life of a wood block pavement is not directly proportional to the travel. Take, for instance, two streets laid with the same wood, in the same manner. If the traffic on one street approaches but does not reach the limit of durability of the wood, the pavement will last almost indefinitely because the character of the traffic is not suffi-

ciently heavy to destroy it; but if this traffic in its character as well as amount passes the limit of durability of the wood employed, the pavement will be destroyed in a comparatively short time. It would seem that for each class of timber there is a condition of traffic beyond which it should not be subjected, but no determination of these limits could correctly be made except from a great number of actual service tests. In a general way, however, satisfactory results may be obtained by dividing the streets into three classes: heavy, medium and light travel. On the third class of streets practically any wood which would not decay would give an indefinite life. On the second class discrimination should be used, although woods as soft as Norway pine have given excellent results under these conditions. On the first class of streets it would probably be dangerous to lay any wood less durable and resisting than the best quality of long leaf pine. So far the writer does not know of any available wood other than the black gum before mentioned which could be safely included with long leaf pine in this category. By this, of course, is meant woods which can be obtained in large quantities commercially, and which possess the element of toughness rather than that of extreme hardness.

While in Havana last July the writer saw San Rafael Street, beautifully laid with native hard woods, mostly mahogany, untreated. The surface of this pavement was almost as smooth as glass and excessively slippery, so much so, indeed, that large areas of other streets in the city, paved with the same material, have been gone over by workmen with small chisels, who have cut the surface of the pavement into a sort of checker board of grooves so as to permit horses to safely travel over it. A somewhat similar, although not so extreme condition has existed on many streets in London laid with Australian hard woods, and the slipperiness of these woods has been the reason why they have so largely been laid with a wide joint between the blocks, this joint being filled with pitch and crushed stone or gravel so as to give horses a foothold. The result of laying pavements in this manner is soon to give a rounded or cobble effect, due to the edges of the blocks wearing off, thereby destroying one of the chief advantages of a wood block pavement. The practice of laying blocks with a tight joint is increasing in London as the use of the Australian hard woods is decreasing. It will thus be seen that the element of toughness and durability in a block is not the same thing as extreme hardness of the wood. Beyond a certain limit many woods are too hard to make a successful paving material.

Among the woods listed for the proposed test by the Department of Agriculture in New York, above referred to, it seems improbable that there will be found any woods possessing the advantages of either long leaf pine or black gum for paving material. The scrub oak, if it existed in large quantities, might make a very durable wood but for the fact that oak, owing to its great tendency to split when subjected to heat, is a very difficult wood to treat. Maple, the writer is inclined to believe, would prove slippery, and Virginia pine, loblolly pine, short leaf pine and the other inferior grades of pine would not make block suitable for the heaviest travel.

The writer recently tested a number of South American woods, some of them so dense that their absorption under the usual time of treatment was only four pounds of creosote oil to the cubic foot, running down to others which absorbed forty pounds. Some of these woods may prove useful for paving block purposes, but the great difficulty would be in separating the different kinds of wood. The tropical forests contain from twenty to twenty-five different kinds of woods, indiscriminately throughout the forest and not in large bodies of any one kind of wood. In getting them out these forests can only be successfully operated by taking out everything, thereby clearing the land for agriculture purposes, and with fifteen or twenty kinds of wood which may be valuable for paving block purposes, the manufacturer would be obliged to separate these woods into several different classes having approximately the same toughness and durability, as otherwise the pavement would naturally wear very unevenly. The writer believes, however, that from this source some very excellent materials can be obtained for street paving purposes. A large enterprise is now under way to get out lumber of this character in the United States of Columbia, and some of it should be on the market in the course of another year.

The Douglas fir, or Oregon pine of the Northwest is almost an ideal material for general paving block purposes. It is not quite so hard or tough as long leaf yellow pine or black gum, and for this reason will probably be excluded from streets of the most extreme travel; but with the exception of perhaps a very few streets of this character it would prove equally satisfactory, and possess the great advantage of being extremely regular and homogeneous in texture so that the difference between hard and soft wood found in the smaller long leaf yellow pine

trees would not exist and pavements could be laid which would wear with perfect regularity throughout their entire surface. There is no opportunity to secure this wood for paving purposes east of the Mississippi River at the present time, but with the completion of the Panama Canal it will no doubt become a very extensively used wood for all purposes in the eastern part of the United States.

Quite recently another wood has been suggested for paving purposes of which the writer has very little knowledge, either as to its physical properties or its availability. This wood is chestnut oak, which is found in western North Carolina, eastern Tennessee and Kentucky, and northern Alabama. It resembles oak, but is softer and less rigid of grain. No experiments have been made with it, but it promises to make a good wood for paving block purposes if it can be obtained in large quantities at a reasonable price.

Recently the writer had a talk with Mr. B. T. Fendall, one of the members of this Association, and the city engineer of Baltimore, Md., who has just returned from a trip of several months through England and the Continent, inspecting foreign methods of paving.

Mr. Fendall stated that he had nowhere in his travels seen as good wood pavements as those now laid in the City of Baltimore. This he attributes first, to the fact that the woods used, Norway and Swedish deal, Pyrenees pine and native French pines are softer than the long leaf yellow pine used in this country, and also to the fact that the blocks are not so thoroughly treated—only 10 pounds of oil to the cubic foot being used as against our 20 or 22 pounds.

Mr. Fendall also exploded some of the prevailing notions about the foreign pavements—notions which are very common and wide spread in this country. One of these is the idea that the English or Continental engineers use extremely heavy concrete foundations under their pavements. This is not true. The heaviest concrete that Mr. Fendall found anywhere abroad was seven and one-half inches in Germany, and the usual practice is six inches, generally gravel concrete. Most of these streets have been paved with macadam for many years and consequently when the sub-foundation is cut through the macadam sub-base looks like concrete and gives a wrong impression to the layman. Any engineer would know that foundations 12 or 14 inches thick, on ordinary well compacted sub-grades would be only a waste of material.

Another point which impressed Mr. Fendall forcibly was the question of repairs. It has been stated time and time again that the foreign streets are so well kept up that repairs are always made with extreme promptness. Mr. Fendall did not find this the case and cited several of the principal streets in Paris with many bad places in them and in need of repairs. He attributes these holes to the use of woods not homogeneous in character and to imperfect treatment which allows some blocks to develop heart rot and quickly affect the surrounding pavement. This action of traffic on streets is one which affects largely the class of timber which can be utilized for street paving work. The writer has found from long experience that streets laid with blocks, some of which are hard and some soft, will wear very badly while the same street laid with all soft blocks would wear very well. This is due to the well known way in which one soft block will affect its neighbors, the wear extending from the one spot like a disease. The most perfect example of this that the writer has seen was in Havana this summer. The United States Wood Preserving Company, some five or six years ago, furnished to the Highway Department of the City of Havana, several hundred yards of yellow pine block for a test on one of the heaviest traveled streets in that city. These blocks were of the old size 4x4 inches and in laying them careless workmen sometimes put them down with the grain horizontal instead of vertical. The street in question has a very heavy travel of two-wheeled carts carrying heavy loads. Six blocks were laid in this street the wrong way. At the end of some five years there are six shallow depressions in this street some 24 inches in diameter and perhaps two and one-half to three inches deep, perfectly regular and having at the bottom of each, in the exact center, a block laid the wrong way. With the exception of these six holes the street is in perfect condition. This shows clearly the way in which a soft block or a block wearing more rapidly than the surrounding blocks will infect, as one might say, its neighbors.

There is a general, although erroneous, idea widespread in this country, that abroad the bulk of the paving is done with Australian hard woods. This is by no means true. The use of these woods is decreasing abroad. The English engineers have almost given up the use of the Karri wood, although Jarrah is still employed to a considerable extent. It is laid untreated, with an open joint to prevent slipping, as above stated.

On the Continent, especially in Germany, tallow wood is liked better than either of the others, but none of the three are in great favor. Mr. Fendall learned in Germany that the German engineers

use large quantities of wood laid with close joints, on grades, because this pavement is less slippery than asphalt. It is fair to say that the asphalt employed is rock asphalt.

So far as our experience has gone it seems true that the best woods for paving block purposes are those which are dense and homogeneous—with little, if any, difference between the durability of different parts of the block, tough rather than hard, and capable of treatment without danger of warping or splitting.

In addition, from a commercial standpoint, it should be necessary that such woods are obtainable in large quantities at reasonable prices. At this time it is safe to name four, in the order named:—Long leaf yellow pine, black gum, Oregon pine, Norway pine. Beyond these it is not certain what the results may be, although short leaf pine and tamarack have both been used in limited quantities, and the writer sees no reason why they should not be successfully employed if used on suitable streets.

The question is one upon which continued experimentation will throw more and more light as more tests are made and more results tabulated. To draw general conclusions from insufficient evidence is as useless in this as in any other subject.

NOTES ON STREET LIGHTING.

By John I. Mange, Manager Light and Power Co., Watertown, N. Y.

A special and very important department of lighting has to do with streets and other outdoor spaces. It involves not a few unusual difficulties for there is unlimited space to deal with as well as an indefinite variety of natural and artificial obstructions. Save in narrow streets bordered by high buildings, one gains little or nothing from the diffusion that is so important a factor in interior lighting and in many instances the streets are so thickly shaded by trees that the problem of adequate lighting is very difficult and one for which local data are necessary for its solution, if it is to be done properly. The amount and distribution of streets and the needs and distribution of the population are the controlling factors in the matter and obviously these vary greatly from place to place.

It is interesting to note that it is now about twenty-five years since the electric arc was first applied to street lighting and it has proven itself to be really the only source of light profitable to consider.

The incandescent lamp is by no means to be thought unfit for service as many of them are now doing admirable work in small towns, in suburbs of cities and in many blind alleys and courts where the expense of an arc lamp is unnecessary. However, at the same total cost, the arc lamp gives a considerably higher average illumination and experience shows that on the whole, arcs which have to be inspected at frequent intervals for the purpose of trimming are kept nearer their point of maximum efficiency than incandescents.

In streets where shade trees hang very low and the foliage is very heavy, arc lamps are at a great disadvantage. Here as well as in many other places where there is no real need of a brilliant light, the incandescent is capable of doing good service at a moderate cost. Economy also sometimes dictates caution in the expenditure for street lighting and in most cases recourse can be had to the incandescent.

The incandescent lamp is usually fifty, seventy-five or one hundred candle power when operated in series with the arc lamps, and sixteen, twenty-five or thirty-two candle power when worked in series upon an alternating current circuit of one thousand or two thousand volts, taking two or four amperes. It should be noted, however, that lamps so operated are costly in the matter of renewals and difficult to operate satisfactory.

In view of the rapid deterioration of the brilliancy of the incandescent, it is not wise to space them over one hundred and twenty feet apart for good service; although in heavily shaded streets if one hundred candle power lamps are used and placed on alternate sides of the street, the space between consecutive lights may be three hundred feet and still produce a fairly well lighted street.

This makes the first cost of installation rather high and therefore the cost per year to the city is higher, relatively than the arc lamp. For a fifty candle power lamp, the average price is twenty-five to thirty dollars a year.

Gas lamps have been used with considerable success much in the same manner as incandescent electric lamps are used. The old style open flame lamp was a very wasteful one burning eight or twelve cubic feet of gas per hour with little illumination.

With the advent of the incandescent

mantle burner, gas lamps became quite popular and are used now to some extent. These lamps are economical, burning only three and one-half to four cubic feet per hour. The average price for such service is about thirty dollars per year.

They are, however, open to the objection that they must be individually lighted and extinguished. The rapid shrinking of the mantles with a diminution of candle power is another bad feature.

Gasoline lamps with individual tanks have been put on the market but to the writer's knowledge no success has been attained.

For about ten years the only available arc lamp was the open full arc of two thousand nominal candle power. These lamps are operated at a high amperage, approximately ten amperes, with a low arc voltage, producing a powerful white glaring light near the lamp and when fitted with clear globes offered a method of illumination which impressed and satisfied the general public who became accustomed to it and thought the more glaring the light, the better the lamp and system while in fact the glare is the most serious objection to the open arc because of the fact that in the presence of lights of great brilliancy the eye contracts and does not recover promptly enough in passing beyond the glare to get the full value of the relatively feeble light at a distance from the lamp.

There are many other objections to the open arc, one of which is the heavy shadow it casts due to the fact that the lamp burns with a very short arc, the upper carbon in the form of a crater and the lower carbon to a point which intercepts the light emitted by the crater of the upper carbon. The heavy side rods necessary cause excessive shadows in two directions. The arc travels around the carbon quite rapidly and being open is affected seriously by wind and weather causing a very unsteady and flickering arc and an uneven and poor diffusion of light.

These lamps have to be visited each day for trimming, which is a large expense that is indirectly borne by the municipality.

To meet the demand for cheaper light the "Half Arc" of twelve hundred nominal candle power was introduced. This, however, had the same objectionable features as the full arc, except the glare in the vicinity of the pole was less aggravating.

The inclosed arc lamp is by far superior to the open arc. In it we have a long arc burning in an enclosed globe in which the air is practically free from oxygen. Although most of the light comes from the crater, still a greater percentage is emitted directly by the arc itself owing to its length.

A large portion of the crater's area is visible over a wider vertical angle and the crater is not so concave as in the open arc; hence less concentration and better distribution of light. The principal variation in the light of an inclosed lamp is caused by the travel of the arc over the flat carbon ends.

This variation can be greatly reduced by the use of an opal enclosing globe which becomes luminous all over and obliterates the shadows which would otherwise be cast by the side rods and lower carbons. Even if we used a clear enclosing globe, the shadows are not so strong in contrast as those of the open arc.

There are two classes of enclosed arc lamps; the direct current and the alternating current. When consuming approximately the same watts at the arc the direct current lamp gives slightly more light than the alternating current both at the lamp and at the light intersecting point. The difference, however, is slight and is made up by the better distribution of light to be obtained from the alternating current lamps.

It seems to me that the arguments to be found against the open arc lamp are so strong that it is practically eliminated from consideration by any municipality.

While the direct current enclosed arc lamp emits as much light when consuming the same energy as an alternating current lamp, it requires special generating apparatus which is more expensive than the static apparatus necessary for alternating current lamps and there seems to be little excuse for the installation of such a system at the present day.

Alternating current arc lamps may be had that consume any amount of energy; from two hundred eighty-five watts to four hundred and eighty-five watts. The lamp chosen will determine the number necessary in a given distance to light properly.

The number of lamps per mile is governed to a great extent by established location, distance between cross streets, length of blocks and other local conditions. Nevertheless, the greater economy and superior illuminating value of small units is well worthy of consideration.

While with a constant arc voltage, the candle power of an arc lamp increases in proportion somewhat more rapidly than the watts, the lighting distance increases only as the square root of the candle power. It is therefore more economical to work with the lower efficiency arc at a

short distance than with the higher efficiency arc at a long distance.

There are four standard units of the alternating current enclosed lamp, viz.: 485 (7.5 amperes)—425 (6.6 amp.)—350 (5.4 amp.) and 285 (4.4 amp.) watts per lamp. The distance to which these units will project a given illumination is 247-227-197 and 178 feet respectively, with a corresponding watt consumption per mile of 5,180-4,940-4,690 and 4,235, thus showing in favor of the 4.4 ampere lamp, a saving of 945 watts per mile over the 7.5 ampere lamp for the same illumination midway between lamps, and with the additional advantage of approximately more brightly illuminated areas along the street.

By maintaining 5,180 watts we can run slightly over eighteen 285 watt lamps per mile. While the small unit will light a greater distance per watt, the advantage is somewhat offset by the increased cost and maintenance per mile for the additional small units required.

There has been developed in the last year a lamp that is a wonderful improvement over all type of lamps; it is the luminous arc lamp made by the General Electric Co. It is a direct current lamp of four amperes operated by either the Brush machine or Rectifier Tubes. This lamp operates with about three hundred to three hundred and twenty watts at the terminals and gives an effective illumination about 30 per cent. greater than the enclosed arc, either series direct or series alternating. Tests have shown that the direct current arc with 480 watts at the terminals gives a certain illumination at 257 feet, the series alternating enclosed arc with the same energy gives the same illumination at 247 feet while the luminous arc gives the same intensity at a distance of 325 feet. It is absolutely steady and casts no shadow. It has a life of 180 hours as against 80 hours for the other lamps and requires only one electrode at each trimming.

Many cities who are installing new systems have chosen the luminous arc lamps and the writer is installing them in Watertown, N. Y. The choice of globes for the enclosed arc lamps is a matter of some importance. Tests show that the opal enclosing and clear outer globe is a combination that gives the best results; the explanation being that the strongest light throws from the arc at an angle of 35 to 40 degrees below the horizontal while it brilliantly illuminates the lower portion of the globe which diffuses the light upwardly and compensates for the loss by absorption through the useful angles.

A 6.6 ampere series alternating lamp has under test projected light through various combinations of globes as follows:

Opal enclosing and clear outer ...227 ft.
Clear enclosing and clear outer..207.9 ft.
Clear enclosing and opal outer...192.4 ft.
Opal enclosing and opal outer...188.5 ft.

To advise in the abstract concerning the hanging of arc lamps is almost impossible as local conditions practically force the use of one or the other of the various ways. Mast arms and cross suspension are generally used where the wires are overhead.

Pole top fixtures are used occasionally in public squares but are not very desirable where any other form of support can be used.

Where the system is underground, ornamental poles are desirable. The distance above the ground arc lamps should be hung must be determined for each individual lamp. For open arcs the distance should be about thirty feet, for series direct current enclosed lamps twenty two feet, for series alternating enclosed lamps eighteen to twenty feet, for the luminous arc about thirty feet. However, in heavily shaded streets it has been found desirable to hang lamps as low as twelve feet from the ground.

Contracts for arc lighting should never be drawn on the basis of a nominal candle power. They should clearly specify the kind of arc to be installed, the amount of energy to be taken in each arc and the kind of shades to be used. The nature of the fixture should be specifically designated whether pole top, brackets, mast-arms or cross suspension as well as the height above the street each lamp should be hung. These and the location of the lamps should be designated by some one familiar with practical street lighting with due consideration for each peculiar local condition. The hours of lighting should be distinctly stated with rebates for failure to provide continuous light within these hours. Such rebates should be merely nominal for deficiencies up to one or two per cent. of the total hours of lighting and punitive on an increasing scale for greater deficiencies. With all these things definitely stated in the contract and carried out by the contractor there only remains to deliver to each lamp the requisite quantity of current to insure good street lighting.

THE CONVENTION.

The thirteenth annual convention of the American Society of Municipal Improvements was held in Birmingham, Ala., October 9-12, 1906. It was called to order on Wednesday afternoon by President Charles Carroll Brown and carried through most of the heavy program outlined in the last number of MUNICIPAL ENGINEERING. A few of those promising papers were unable to be present or to supply their papers, but there was no lack of business for the society to transact and the last session on Friday was held to a late hour, in order to complete the discussions in which the members were interested. Many of the papers are printed herewith, and those which could not be presented this month, for lack of space, will appear later. It is not necessary, therefore, to report this part of the meeting.

The local committee, of which Julian Kendrick, city engineer, was the efficient chairman, provided a carriage ride about the city and to the waterworks on Wednesday. Before starting on the trip Mr. James Bowron, one of the men who has been instrumental in developing the Birmingham district, gave a most interesting description of the natural advantages of the district, laying especial stress on the close proximity of coal, limestone and iron to each other and the consequent economy possible in the manufacture of iron. He also sketched the improvements made and in progress, whereby the quality of the iron has been improved until it is now equal to the best, and the process of manufacture has at the same time been greatly cheapened. He also called attention to the future possibilities of the district when it secures the water transportation now almost in sight, and when the opening of the Panama canal gives it a long lead over any other steel manufacturing district.

The drive took the party over miles of bitulithic pavement, all apparently in good condition, with occasional samples of brick and granite block pavement. Many chert streets and roads were also seen during the trip about the city, and on the country roads leading to and from the waterworks. A chert quarry or two were passed on the way. The paper on "Chert Roads" gives the story of this material and the rutless roads made of it.

The waterworks company has overcome great obstacles in pumping its supply from a stream, which is removed from any present or near future pollution, over a mountain to a reservoir, where it passes through mechanical filters and serves the city by gravity. The society was the guest of the water company for a southern barbecue on the return trip.

Thursday's trip was by courtesy of the L. & N. R. R., over the mineral road which supplies raw materials to the furnaces, pipe and brick works, etc., and carries away the finished products. There was time to visit only sample plants, including a great steel rail mill, the iron mine supplying it in part, a slag cement mill, a vitrified pipe factory, and a cast iron pipe foundry. A few of those specially interested visited the septic tanks near Bessemer, which treat all the sewage of the district. Fuller description of the sewerage and sewage disposal plans will be given later.

The exhibit committee, under the energetic guidance of the chairman, Mr. R. K. Davis, of the Garbage Reduction Co., Detroit, Mich., made a very satisfactory showing, although the time allotted to him was very short and the distance and high freight rates kept many northern firms away. The A. L. Barber Asphalt Co., New York city, showed samples of Bermudez asphalt and many photographs of streets laid with this material. The company sells the asphalt to contractors engaged in asphalt paving. The Birmingham city laboratory made an interesting exhibit of bacteriological methods and results, with an invitation to visit the laboratory itself. The Reinforced Concrete Pipe Co., Jackson, Mich., showed some pipe made ready for laying and distributed its catalogues. This company has recently done much excellent work in the south and some of its work in Knoxville, Tenn., will be shown later. The United States Wood Preserving Co., New York city, showed samples of wooden paving blocks treated by their process. The Barrett Manufacturing Co. showed samples of Tarvia and photographs of roads in process of construction and completed, reproductions of some of which will be found elsewhere in this number. Warren Brothers Co., Boston, Mass., occupied the center of the room with an excellent exhibit of samples of pavement, materials and methods, with photographs and literature. The best exhibit of the company was, however, the miles of excellent pavement in use in the city of Birmingham. The delegates seemed to appreciate the conveniences furnished for them. The Graves Shale Paving Brick Co., Birmingham; the Southern Clay Manufacturing Co., Chattanooga, Tenn.; the Southern Cement Co., Birmingham,

PRES. M. R. SHERRERD
Newark, N. J.

SEC'Y GEO. W. TILLSON,
Brooklyn, N. Y.

THIRD VICE-PRES. FRED GIDDINGS,
Atchison, Kan.

TREAS. L. V. CHRISTY,
Wilmington, Del.

and the Southern Sewer Pipe Co., Birmingham, were local firms making exhibits of excellent materials. The Thompson Meter Co., Brooklyn, N. Y., and Municipal Journal and Engineer, New York City, were also exhibitors.

The officers elected were for the coming year were Morris R. Sherrerd, president, Newark, N. J.; James Owen, first vice-president, Newark, N. J.; Julian Kendrick, second vice-president, Birmingham, Ala.; Fred Giddings, third vice-president, Atchison, Kan.; Geo. W. Tillson, secretary, Brooklyn, N. Y.; L. V. Christy, treasurer, Wilmington, Del.; A. F. Eggers, Newark, N. J.; T. C. Hatton. Wilmington, Del., and R. H. McCormick, Detroit, Mich., finance committee.

The following list contains the names of new members elected at the convention and of those registered, and includes both active and associate members:

Atchison, Kan: Fred Giddings, city engineer.

Augusta, Ga.: Nisbet Wingfield, city engineer.

Austin, Tex.: C. E. Leonard, city engineer.

Birmingham, Ala.: J. E. Donelson, Southern Bitulithic Co.; J. M. McCartin, superintendent of streets; Julian Kendrick, city engineer; Geo. H. Clark, Memphis Asphalt and Paving Co.; R. E. Meade, consulting engineer; C. H. Dickinson, Southern Cement Co.; J. A. Millson, Southern Sewer Pipe Co.; G. C. Engstfeld, Southern Clay Manufacturing Co.; H. S. Matthews, Graves Shale Paving Brick Co.

Bonne Terre, Mo.: John M. Monie, municipal engineer.

Boston, Mass.: Ralph L. Warren, secretary Warren Brothers Co.

Brooklyn, N. Y.: George W. Tillson, engineer of highways.

Brunswick, Ga.: Chas. S. Wylly, city engineer.

Chattanooga, Tenn.: W. M. Lasley, T. H. Lasley and R. H. Parker, Southern Clay Mfg. Co.

Cincinnati, O.: S. H. Weissleder, engineer Bell Telephone Co.; L. L. Clements, U. S. Wood Preserving Co.

Columbus, O.: Julian Griggs, consulting engineer.

Dallas, Tex.: E. L. Dalton, city engineer; L. L. Bristol, building inspector.

Detroit, Mich.: Robert C. Davis, Garbage Reduction Co.; R. H. McCormick, city engineer; J. K. Mitchell, general assistant city engineer; Wm. F. Day, engineer of sewers; Geo. P. Codd, mayor.

Easton, Pa.: A. Prescott Folwell, professor Lafayette College, editor Municipal Journal and Engineer.

East Orange, N. J.: W. H. Reimer, city engineer; Wm. Solotaroff, superintendent shade tree commission.

Gadsden, Ala.: W. M. Wilson, city engineer.

Helena, Ark.: Francis H. Wright, city engineer.

Henderson, Ky.: R. W. Ball, city engineer.

Huntsville, Ala.: F. E. Murphy, street superintendent.

Indianapolis, Ind.: Charles Carroll Brown, consulting engineer, editor MUNICIPAL ENGINEERING.

Jackson, Mich.: W. W. White and A. J. Mead, Reinforced Concrete Pipe Co.

Kingston, N. Y.: Edward B. Codwise, city engineer.

Little Rock, Ark.: W. F. Reichardt, engineer Southwestern Telegraph and Telephone Co.

Mobile, Ala.: John Craft, city council; Wright Smith, chief engineer Board of Public Works.

Montgomery, Ala.: Allen R. Gilchrist, city engineer.

Nashville, Tenn.: G. M. Ingram and John A. Wilson, Southern Bitulithic Paving Co.

Newark, N. J.: Augustus F. Eggers, Frank J. Bock, C. V. Baumann, J. S. Vinson and A. R. Denman, of the Board of Works; Edward S. Rankin, engineer sewer department; Chas. M. Shipman, superintendent of works; M. R. Sherrerd, chief engineer of Board of Works; James Owen, consulting engineer.

New Orleans, La.: Geo. G. Earl, general superintendent Sewerage and Water Board.

New York City: E. J. Snow, Thomson Meter Co.; J. C. Rock, A. L. Barber As-Co.; J. W. Howard, consulting engineer, 1 Broadway; Wm. S. Crandall, 253 Broadway; F. A. Kummer, U. S. Wood Preserving Co.; A. L. Barber Asphalt Co., 17 Battery Place; Barrett Mfg. Co., 11 Battery Place; Allen W. Dow, consulting chemist, 120 E. 23d st.; Geo. W. Fuller, consulting engineer, 170 Broadway; P. W. Henry, consulting engineer, 17 Battery Place.

Philadelphia, Pa.: Geo. S. Watson, consulting engineer, 54 Baxter building.

Pine Bluff, Ark.: W. J. Parkes, city engineer.

St. Joseph, Mo.: Wm. H. Floyd, Jr., consulting engineer.

Spartanburg, N. C.: Geo. O. Tenney, president Atlantic Bitulithic Co.

Toronto, Ont.: C. H. Rust, city engineer.

Tuscaloosa, Ala.: Prof. Edward B. Kay, University of Alabama.

Valdosta, Ga.: W. H. Gainey, city engineer.

Watertown, N. Y.: Frank A. Hinds, consulting engineer.

Wilmington, Del.: T. Chalkley Hatton, consulting engineer; L. V. Christy, secretary street and sewer department.

Winston-Salem, N. C.: J. L. Ludlow consulting engineer.

EDITORIAL COMMENT

A Valuable Association for Municipal Officers.

Sewage Disposal.

A VALUABLE ASSOCIATION FOR MUNICIPAL OFFICERS.

This number of MUNICIPAL ENGINEERING is very largely devoted to the proceedings of the Convention of the American Society of Municipal Improvements, held at Birmingham, Ala., Oct. 9-12. No apology is offered for so doing for two very good reasons: It would be difficult to find a better series of articles, more nearly up to date than that contained in the program of the convention, all of them in the field to which this magazine is devoted. Our readers have come to expect the first and fullest report of the convention in the first number following its adjournment.

The Association is not very large and its conventions are not largely attended, but it is made up of experts in municipal improvement and men who have something to say, whether belonging to the society or not, are always ready to accept invitations to lead in its discussions if they can be present. The consequence is the valuable collection of papers, most of which we give this month. Several of those who expected to be present with papers were detained for one reason or another, perhaps fortunately, because it would have been physically impossible to crowd all the wealth of the printed program into the time set for it. Experience has shown that such allowance must always be made.

Those attending the convention expressed themselves uniformly as well pleased with their entertainemnt. While the program was excellent, the hearty welcome and the good treatment by the local committee contributed very largely to this feeling. The drive on Wednesday over the pavements of the city and across the mountains to the various parts of the water supply system, and the ride on Thursday around the Birmingham district on the mineral road were of great interest, especially to the northern visitors, who were taking their first view of the results of public and private enterprise in developing the vast natural resources of the region. The time was well spent and the instruction received was invaluable. Mr. Kendrick favored those specially interested with a side trip to the sewage disposal plant constructed for the district by the county.

Another of the attractions was the instructive exhibit of paving and sewerage materials, cement and water meters. The exhibit committee labored under the disadvantage of short time for securing exhibitors but obtained so satisfactory a result that it should not be difficult to secure a much larger number of exhibitors next year on short notice.

The municipal officials among our readers, as well as engineers, contractors and agents engaged in municipal business would do well to join the society and secure all the benefits thereof. The next meeting will be held in Detroit, the third week in September, 1907, the best time for a visit to that interesting city.

SEWAGE DISPOSAL.

During the past summer Mr. C. H. Rust, the city engineer of Toronto, visited England and submitted to Mr. Geo. R. Strachan, a consulting engineer in London, the plans which he proposed for disposing of the sewage of the city of Toronto.

The city is located on Lake Ontario, draws its water supply from the lake through a tunnel extending out to 70 feet depth of water, and at present discharges its sewage into the lake, the harbor which is connected with the lake by three channels, or streams discharging into them. Mr. Rust prepared three methods of sewage disposal for consideration. First, a tunnel sewer to discharge the crude sewage into the lake nine miles east of the waterworks intake and 2,250 feet from shore in a depth of 25 feet of water. It will be remembered that this point is in the direction of the outlet of the lake and that the currents in the lake are usually very slow, being produced by the wind, and are seldom if ever from the northeast to the southwest, the direction sewage must take to reach the waterworks intake from the proposed outlet. The second method suggested is the use of septic tanks, the effluent to be pumped on 600 acres of land for eight months of the year, with effluent entering streams flowing to the lake; during the four

winter months the effluent to flow to the lake from the septic tanks. The third proposition includes filtration instead of the land treatment and the effluent reaches the lake about 4 1-2 miles east of the waterworks intake.

Mr. Strachan's report upon these three plans is interesting because it presents in condensed form the conclusions to be drawn from English practice regarding these three methods of sewage disposal and compares the various methods of designing and operating filter beds. He does not give figures of cost, but states that the relative economy of construction and operation is in the order in which the propositions are named.

For the conditions of winter temperature at Toronto, Mr. Strachan prefers contact beds to sprinkling filters. He believes that the contact beds are less affected by cold and that the results are therefore steadier all the year round. The expense, however, will be somewhat greater than for sprinkling filters, although the sprinkling filters, especially, must be enclosed in such a climate as that of Toronto and possibly the air supplied to the beds must be warmed in the coldest weather.

The principal question is regarding the effect of the sewage upon the water supply, and Mr. Strachan's conclusions may possibly surprise some who have become passably familiar with English tendencies, for he is quite pronounced in his preference for the discharge of the screened, crude sewage into the lake nine miles northeast of the water intake. He considers the risk to the water supply by this method of disposal of sewage and storm water to be very remote and he does not believe that "either suspended matter or bacteria from the sewage will reach the zone feeding the intake."

The other schemes are more doubtful because they treat only the dry weather flow and the overflows during storms would go into the harbor and lake, as at present. The effluents from the treatment plants also enter the lake at only half the distance from the intake. So far as the effluent from the land filtration scheme is concerned, it is not likely to injure the water supply, and the danger of damage by the effluent from the contact beds is also remote though "more real than in the other schemes."

Mr. Strachan concludes his report by recommending filtration of the water supply on general principles.

The limit of populuation set for the application of the principles stated in the report is 500,000, scarcely double the present population, which has doubled, roughly speaking, each fifteen years in the past thirty. When this limit is reached there must be another study of the problem. It is interesting to see the certainty with which the recommendation is made in the face of the strong reports made recently regarding the addition of pollution to the Hudson river and New York harbor, and the decision at Baltimore to purify the sewage of the city before discharging it into Chesapeake bay. At the present time the conditions in the three places are quite different, but Toronto has much the most delicate problem and dangerous conditions can be developed much more quickly than in either of the other cases. A water supply must be beyond suspicion and the danger of creation of a nuisance, as in New York harbor, or damage to oyster beds, as in Chesapeake bay, is far more remote.

The necessity of considering conditions for all time in such cases must be recognized. With this warning regarding the full acceptance of the conclusions drawn, the report by Mr. Strachan is recommended as a clear and concise statement of the present state of the art of sewage disposal.

THE QUESTION DEPARTMENT

STREET PLAN WITH CONVERGING CURB LINES.

This city intends to do some paving, either this fall or early next spring. One of the streets will be paved to the width of 67 feet at the start, then 42 feet, and will wind up with 30 feet. The whole length of the street is 3,700 feet, and extends from a bridge to a railroad. The intention is to make an offset in the curb line wherever it is to be narrowed and I considered the matter and thought how to avoid the offset by running the curb

line from the widest to the narrowest part at an angle line, and wish to ask you if you know of any street that has been laid out in this manner, or if you could refer me to some city where it has been done, so I can find out if it has proved practical. P. G. W., ———, Kan.

The writer knows of no street which gradually reduces in width from the wider to the narrower end. There is an occasional street which eases off the projection of the curb at the point of reducing the width by a short length of curb on an angle, but this is used in short lengths between streets and alleys where the offsets are in the property lines rather than in the curbs.

In some states it would not be possible to follow the plan given in the letter, because the assessments are made on the property on the basis of equal benefit and the reduction of width in the pavement would give cause for a protest on the ground that the pavement in front of the lot at one end of a block was not of the same width as that in front of one at the other end.

In some of these states it would be necessary to let the contract for the street in three parts, one for each width of street, that the assessments may be uniform. In others this is taken care of by letting the contract on unit prices and assessing the property for the work done in front of it. Were the plan for gradually narrowing the street adopted this would make the lot assessments different per front foot and there would be complaint that the same service would cost one lot owner more than another. Possibly these objections would not be valid under the assessment laws in Kansas.

Can our readers give any examples of streets with converging curb lines as our correspondent proposes? What effect do they have on the appearance of the street? How is the assessment of benefits distributed?

BUILDING ORDINANCE.

Can a building permit ordinance be made that will be legal and effective on streets that are proposed, but not opened, title to the land not having been acquired by the town, but surveyed and approved by the council with the intention of having such streets opened as soon as, in the judgment of the council, it is deemed proper.

The ordinance is simply designed to prevent the erection of buildings in the line of said streets, the streets being laid out as a matter of public policy.

W. S. Fallis, Supt. Public Works,
Harrisonburg, Va.

This question can be discussed only in a general way, because statutes in different states vary and what is a correct procedure in one state may be quite wrong in another.

In general, the making of a plat and its presentation to the city government for approval serve as a dedication of the streets to the public, which is made binding by an approval ordinance passed by the council. This is true, whether the fences are actually thrown down and the boundaries of the streets are indicated or not. Any one building on a street so dedicated would be trespassing upon public property and could be forced to remove his structures and restore the ground to its original condition. If the dedication is not yet completed in legal form the property, streets and all, still belongs to the owners who have made the plat and probably it would not be possible to make a building ordinance which will prevent the suggested location of buildings on the streets.

How closely the statutes of Virginia conform with the principles stated, and whether the dedication has been completed so that the streets on the plat are actually public property, are questions which should be submitted to the city attorney or some other attorney who is familiar with Virginia statutes and modes of procedure.

SURVEYING IN CUBA.

Will you kindly advise us if you know of any guide for Cuban travelers; also what inducements would there be for a civil engineer changing the Spanish survey to American square survey.

J. L. N., ———, S. D.

No travelers' guide to Cuba is known to the writer. One of the Baedeker series is promised, but not yet ready.

It is hardly probable that a change can be made from the old Spanish surveys to the American rectangular system. This system was applied in the United States only to lands belonging to the government and there are frequent patches of private grants antedating the survey which are not included in it.

GUARD RAILS FOR STREET RAILWAY TRACKS.

I have been asked to bother you again on the subject of guard rails. Here the guard rail is considerably higher than the other rail, owing to the flanges being overlapped in order to bring them closer together. We would like to know if it would not be just as safe for the railway, and safer for the public if the flanges were cut off, which would bring them together, but both rails would be of the same height. W. B. M., ———, Can.

On curves at the foot of steep hills the elevation of the guard rail above the track rail adds to the safety of the device by giving greater holding power on a wheel tending to leave the track. Also, the

groove in which the flange of the wheel runs must be wide enough so that the flanges on the wheels at opposite ends of the wheel base will have room to pass round the curve without being forced up out of the groove. Narrowing the groove makes the elevation of the guard rail more desirable by increasing the tendency of the flanges to mount the rails. On very dangerous curves the construction described in the question has its justification in these facts. The question is as to the proper balance between width of groove or space between rails, height of guard rail and permissible speed on the curve. If cars are always under perfect control there need be no special construction on the curves. It is probably not possible to provide completely for a runaway car. There is again a balance to be struck between the provision considered desirable for cars under partial control and the difficulty and danger of vehicle traffic crossing the street in which the curve is located.

It is customary to have guard rails of special form or with flanges cut off so as to give as narrow a space between rail and guard rail as the operation of car trucks around the curve will permit, and to keep the guard rail closely to the same elevation as the track rail. This should be insisted upon for all curves on streets with comparatively slight grades. The rule may be abrogated to the extent deemed best for the dangerous curves referred to.

BOOKS ON BRICK PAVEMENTS AND STREET CROWNS.

Have you any books pertaining to the construction of brick pavements and street cross sectioning. J. W. C.,
Youngstown, Ohio.

Perhaps the best treatise on these subjects will be found in the chapters in Baker's "Roads and Pavements" ($5) on "Street Design," "Street Drainage," "Curbs and Gutters," "Pavement Foundations" and "Brick Pavements." There are also good chapters in Tillson's "Pavements and Paving Materials" ($5), Byrne's "Highway Construction" ($5) and Judson's "City Roads and Pavements" ($2). Wheeler's little pamphlet on "Vitrified Paving Brick" ($1) is also good.

There are many articles in MUNICIPAL ENGINEERING which will give the latest and most authoritative information on this subject. The crown for brick streets is considered in vol. xiv, p. 248; vol. xvi, p. 241, and elsewhere. Lists of articles on the cost of brick pavement will be found in vol. xxviii, p. 283; vol. xxvii, p. 281. Following are the titles of additional articles:

In vol. xxxi: "Best Pavements for Automobiles," p. 189; "Milwaukee Streets," p. 192; ;"Comparison of Paving Materials by City Engineers," p. 194; "Freezing Tests for Paving Brick," p. 23; "Methods of Filling Brick Pavements," p. 31.

In vol. xxx: "Amount of Brick Paving in Cities," p. 204; "Paving Brick Testing and Inspection," p. 227; "The Brick Industries in 1905," p. 295; "Paving Brick and Pavements," p. 298; "Paving Country Roads," p. 299; "Tests for Paving Brick," p. 426.

In vol. xxix: "Brick Pavements for Small Cities," p. 30; "Brick for Street Paving," p. 420; "Pavements in American Cities," p. 429.

In vol. xxviii: "Condition of Chicago Streets," p. 42; "Brick Pavements," p. 112; "Paving Brick Testing and Inspection," p. 235; "Joint Fillers for Brick Pavements," p. 238; "Cement Filler for Brick Pavements," p. 294; "Traction Tests on Brick and Asphalt Pavements," p. 334; "Suggestions on the Construction of Brick Pavements," p. 366; "Detroit's Proposed Paving Brick Plant," p. 389; "Brick Pavement Specifications," p. 435.

In vol. xxvii: "Paving Materials," p. 96.

There are many others in preceding volumes.

MUNICIPAL ELECTRIC PUMPING PLANTS.

Would you be kind enough to give me some data as to any cities that are now owners of their own waterworks and are using electric power for pumping.
W. B. M., Evansville, Ind.

The city of Toronto, Ont., has a high pressure water system for fire purposes, which is operated by electricity. DeKalb, Ill., and Lawrenceville, Ill., both small cities, and Fresno, Cal., with 13,000 population, are the only other waterworks systems known to the writer which operate by electricity.

BOOKS ON FILTRATION AND ANALYSIS OF WATER.

Will you kindly advise me what book or books you consider best treat the subject of mechanical filtration of municipal water supply; also what books best treat the analysis of water. J. F. I.,
Monessen, Pa.

Hazen's "Filtration of Public Water Supplies" ($3) is the standard work on water filtration, but it devotes only one chapter to mechanical filtration. Fuertes's "Water Filtration Works" ($3.50) devotes a larger proportion of its space to this method of filtration. The most ex-

haustive studies of mechanical filtration will be found in the reports of the experimental plants at Louisville, Cincinnati, Pittsburg and New Orleans.

Perhaps the best chapters on chemical analysis will be found in Mason's "Water Supply" ($5). Books on the biological and bacteriological examination of water are Whipple's "Microscopy of Drinking Water" ($3.50); Prescott and Winslow's "Elements of Water Bacteriology" ($1.25) Rafter's "Microscopical Examination of Potable Water" (50 cents).

DROP MANHOLES—CONCRETE SEWERS.

I should like some literature on the subject of drop manholes. Have you in any of your volumes discussions of them? Our topography is such that these would be very beneficial. I want the best work obtainable on concrete sewers.

F. D. B., Shawnee, Okla.

There is but little in print on the subject of drop manholes.. Folwell's "Sewerage" ($3) gives one design, which consists of an ordinary manhole with a connection directly to the straight sewer and another connection by means of a T in the bottom of the straight sewer, which leads the sewage down a pipe laid outside the manhole and into the manhole at or near its bottom.

It is not uncommon to lay the sewer at the most economical slopes and depths to a point, say 10 or 20 feet from the manhole and then run on as steep a gradient as is necessary to discharge near the bottom of the manhole. For ease in inspection and cleaning of the sewer the inlet should be above the bottom of the manhole a distance, depending on the gradient, sufficient to give easy access to the pipe. For drops in the main sewer, concrete manholes may be used or concrete linings. To break the force of the drop of the water in the manhole the surface should be curved to keep the water in contact with it as nearly as possible and curved in the reversed direction at the bottom with as easy a curve as possible, to prevent the wear of vertically dropping water and gradually to reduce the velocity of flow in the sewer below. Perhaps some of our readers will supply plans of drop manholes with comments on the success of the design or reasons for trouble with them.

Concrete sewer construction is considered to some extent in Folwell's "Sewerage," but the development of the use of concrete for sewers has been so recent that the text books do not contain the most recent designs. There are several articles in MUNICIPAL ENGINEERING which will be of value in this connection. Following is a list of the most recent:

In vol. xxxi: "A Low Cost Concrete Culvert," p. 315; "Reinforced Concrete Pipe," p. 167; "Renewing Railroad Waterways with Concrete Culverts," p. 9; "Cost of Concrete Sewers," p. 20.

In vol. xxix: "Joint Trunk Sewer of Eleven New Jersey Municipalities," p. 412.

In vol. xxviii: "Qualities of Cement Sewer Pipe," p. 30.

In vol. xxvii: "Reinforced Concrete Sewers in Wilmington, Del.," p. 248.

In vol. xxv: "The Concrete Sewer on Northwestern Avenue, Indianapolis," p. 182.

In vol. xxiv: "Concrete Sewers," p. 253.

In vol. xxii: "Concrete Sewers," p. 19; "The Use of Concrete in Sewer Construction," p. 169.

The "Hand Book for Cement Users" ($3) contains considerable information on concrete for sewers.

INFORMATION ABOUT FIRE RESISTING QUALITIES OF CONCRETE.

The special committee to collate literature on the Fire Resisting Qualities of Concrete, appointed by the Joint Committee on Concrete and Reinforced Concrete, solicit your assistance.

We wish to be put in touch with all literature on the subject under investigation which has appeared in American and Canadian publications for the past several years.

Therefore, will you kindly refer us to the numbers of your journal which contain anything bearing upon the subject "Fire Resisting Qualities of Concrete?"

C. W. BOYNTON, Chairman,
Chicago, Ill.

The following articles in MUNICIPAL ENGINEERING contain information regard the action of concrete when subjected to the action of fire:

In vol. xxxi: "Conclusions from the San Francisco Fire," by S. Albert Reed, p. 283; "Building Materials in the San Francisco Earthquake," by Wm. Ham. Hall, p. 170; "Fire Protection," by the editor, p. 18; Building Ordinances Governing Concrete Blocks," in the Question Department, p. 26.

In vol. xxx: "Fire Test of Reinforced Concrete," by R. P. Miller, p. 1; "Are Concrete Chimney Blocks Fireproof?" in Question Department, p. 282; "Reinforced Concrete Withstands Earthquake and Fire," p. 375; the San Francisco Fire, by the editor, p. 428.

In vol. xxix: "Concrete Block Insurance and Resistance to Fire," by S. L. Wiltse, p. 120; "Concrete Blocks and Fire Insurance," by E. T. Cairns, p. 130; "Investigation of the Effect of Heat Upon the Crushing Strength and Elastic Properties of Concrete," by Prof. I. H. Woolson, p.

188; "Fire Test of Miracle Blocks," p. 305.

In vol. xxviii: "Fire Tests of Concrete," by Prof. I. N. Woolson, p. 47; "Hollow Concrete Blocks Fireproof," (illustrated), p. 490.

CONSTRUCTION OF SILOS.

I see inquiries about building silos in the October number. I am building a silo. It is to be 45 feet high and 18 feet diameter. I have got 35 feet of it built and filled. We had to fill it becauuse our corn was getting too ripe. I will commence tomorrow running it on up. I will then put on a concrete roof and then I will run it 8 feet higher for a water tank on top. The whole height will be 53 feet. This silo is built of concrete blocks made on the Ideal block machine, 8x8x16 inches. There will be no reinforcement in my walls until I start my water tank.

I would not give one cent for forms. I can take the Ideal block and build silos or anything else I think better than with forms. There will be three more built on the same farm. I am putting this up under a guarantee and I will do the same for any one wanting anything of the same kind. It is much prettier built of blocks than plain walls of concrete. My water tank will have a 6-inch wall inside the 8-inch block wall and that will be reinforced and braced to the 8-inch wall. Then I will put a concrete roof on top, cornice and ventilator. When I have this done it is going to be the prettiest and best silo in the United States. T. J. N.

Greenville, O.

ABOUT WHITE PORTLAND CEMENT.

I would like to know something about White Portland cement.

S. L. EGGERT,
Kirksville, Mo.

White Portland cement is a product which has not been manufactured except in the laboratory, but a plant is now in process of construction for the manufacture of a true Portland cement which will closely approximate a white color, and the cement will be manufactured in commercial quantities before 1907 begins by the Art Portland Cement Company of Kimmell, Ind.

There has been a constant and earnest inquiry for a white Portland cement for some years, first for its non-staining qualities, and second, for artistic uses of various kinds.

Non-staining cement is needed for setting fine stone masonry, for statuary and for ornamental structures. Ordinary cement will stain any material, even if only slightly porous, with which it comes in contact when the mortar is green. There are some puzzolans and grappier cements which are very nearly non-staining and these have been used where lime mortar would not be satisfactory. They usually command a high price in the market because the supply is scarcely equal to the demand.

Many inquiries come to MUNICIPAL ENGINEERING for a cement which can be used for making monuments, statues, ornamental work for buildings, lintels, cornices, window and door frames, artificial stone, and the like. The ordinary Portland cement does not lend itself to imitations of the lighter colored stone, and the bluish or yellowish gray of artificial stone made with it has aroused a prejudice on account of the vast amount of cement work which has been put up in the most inartistic fashions possible, so that the cement color has become a sign of cheap and ignorant workmanship and anything which has it is condemned without further examination. Some day this prejudice will be overcome by the good design and good workmanship which is gradually gaining ground in this country, but, meantime, there is a demand for a white cement which is as strong and as weatherproof as Portland cement and which will retain its color and permit the aggregates of which the stone is made to show their natural colors. There has been nothing to supply this demand and the first definite promise of anything is that made by the Art Portland Cement Company. This company promises a true Portland cement which will be very nearly white in color, non-staining, and will also have considerable waterproofing quality. If it can fulfill its promises there will be an extension of the use of Portland cement which will be limited only by the supply.

SYSTEMS OF STEEL REINFORCEMENT OF CONCRETE.

Please give me the names and addresses of all the cement steel reinforcing systems with which you are acquainted.

D. C. H.
Logansport, Ind.

The list is too long to be given in this department. Brief statements of names and characteristics of the various methods of reinforcing cements throughout the world are given in the "Hand Book for Cement Users," ($3) occupying about 14 pages. The names of those supplying steel for reinforcement of concrete and of those engaged in reinforced concrete construction will be found in the fourth edition of the "Directory of American Cement Industries," ($5), just issued, in the

department of "Machinery and Supplies for Cement Plants and Machinery and Tools for Cement Users," under the headings, "Concrete Fire-Proof Construction," and "Steel Reinforcement for Concrete." Some names of contractors for reinforced concrete work will be found in the "Business Directory" printed in each number of MUNICIPAL ENGINEERING under the headings "Bridges," "Cement Sewer Pipe," "Concrete-Steel Arch Bridges," "Expanded Metal Construction," "Fireproof Construction," "Reinforced Concrete Construction," "Reservoirs, Concrete."

SIEVES FOR TESTING FINENESS OF CEMENT.

From whom can I get information about the price, etc., of the standard sieves recommended by the American Society for Testing Materials as per your hand book?

F. L. M.,
Scranton, Pa.

Reference to the "Business Directory" printed in each number of MUNICIPAL ENGINEERING under the heading "Cement Testing Machines" will give you names of firms who can supply the information desired.

EGYPTIAN PORTLAND CEMENT CO.

Is there such a firm as the Egyptian Cement Co. at Fenton, Mich.? Do they make a good cement? And are they in a prosperous condition?

M. A. H.,
Oberlin, O.

The fourth edition of the "Directory of American Cement Industries," ($5), issued in August, 1906, gives the financial standing of the Egyptian Portland Cement Co., of Fenton, Mich., its officers and information about its processes and product. It makes Egyptian brand of Portland cement from marl and clay by the wet process with rotary kilns and should be able to equal other marl cement plants in the quality of its product. The plant has a rated capacity of 1,200 barrels a day and is said to manufacture over 200,000 barrels a year.

INFORMATION ABOUT CEMENT IN DAMS.

What articles have you published on the use of cement in dams? What works cover this subject?

A. B.,
Peekskill, N. Y.

The following articles relating to cement and concrete dam construction may be found in recent numbers of MUNICIPAL ENGINEERING:

"New Columbus Storage Dam," vol. xxx, p. 210; "A Reinforced Concrete Reservoir Dam," vol. xxviii, p. 438; "A Concrete Dam," vol. xxvii, p. 296.

The following books discuss the theory of the construction of concrete dams in certain chapters: Wegmann's "Design and Construction of Dams," ($5); Schuyler's "Reservoirs," ($5); Turneaure's "Public Water Supplies," ($5).

The following books give descriptions of actual structures built of concrete, plain or reinforced: "Hand Book for Cement Users," ($3); Sabin's "Cement and Concrete," ($5); Buel & Hill's "Reinforced Concrete," ($5); Taylor & Thompson's "Concrete, Plain and Reinforced," ($5).

WHO HANDLES COPPER SAND?

Kindly send me the name of some company that handles copper sand.

T. J. K.,
Paris, Ky.

The Lake Erie Asphalt Block Co., Toledo, O., or the New Castle Asphalt Block Co., New Castle, Pa., use so-called copper sand, which is the refuse left after the copper is extracted from the rock in which it is found. If this is what is wanted these firms can supply it or direct inquirers to the source of supply.

LIST OF CEMENT BLOCK MANUFACTURERS.

Do you publish a list of cement block manufacturers of the United States?

T. B.,
New York City.

The "Directory of American Cement Industries," ($5) contains a list of nearly 2,100 makers of artificial stone, hollow cement blocks, and the like.

TIME FOR CURING CEMENT BLOCKS.

How long after a cement block is made in cold, freezing weather should it be taken out of the factory and laid in a wall to have it set enough so that the weather will not affect it?

W. A. H.,
Lee, Mass.

If the factory is warm enough so that blocks do not freeze during the first 36 to 48 hours after they are made they can safely be treated in the same way as blocks made in warmer weather. Blocks subjected to freezing shortly after they are made may have their final set delayed for some hours, some experiments showing the cold blocks to require nearly five times as long to set as warm blocks.

The real question with cement blocks as made on machines, however, is regarding the possibility of sprinkling them until they have attained their full hardness in the curing process. The factory must be warm enough so that this frequent sprinkling can be done for the week or two usually considered advisable, without

danger of freezing the applied water on the surface or immediately within the block. No block should be set in a wall until it has had this curing with the addition of sufficient water to supply that necessary for the chemical action of the cement. The evaporation being somewhat less in cold weather, the sprinkling need not be so frequent but it must be just as faithfully done. At least thirty days' time is required in warm weather and it would be safer to allow sixty days in cold weather if the temperature of the factory is kept but little above freezing point. Greater time for curing is advised. Blocks six months old are enough better to pay for the time of sorage.

INVESTMENTS IN CEMENT PLANTS.

How many cement companies of the United States paid dividends last year and what per cent. on capital invested? Do cement experts think that the supply will keep up with the demand for the next five years or do they think it likely to have an over production on account of the many new plants in course of construction.

Do you consider an investment in a cement mill that would be centrally located, with cheap fuel and a good distributing point a safe and good investment?

A. P., ———, Wis.

There is no means of telling how many cement plants paid dividends last year or what per cents. they paid. Rumor places the dividends of various plants at figures ranging up to 20 per cent. or so, but there are very few definite figures reported. Such definite figures as have come to the knowledge of the writer are in the vicinity of 6 to 8 per cent.

The supply has not been equal to the demand this year, but the cement manufacturers have learned better what price the market will stand and until the season was well over did not increase the price beyond a fairly reasonable figure. This subject was discussed on page 279 of the October number of MUNICIPAL ENGINEERING. It seems to be the general opinion that so long as building operations continue their present activity there will be a demand for all the cement that is likely to be offered next year. A period of business depression would seriously damage the cement market.

The writer has seen no reason to change his opinion as expressed in MUNICIPAL ENGINEERING, vol. xxvi, p. 17, vol. xxviii, p. 228, and elsewhere and corroborated in an article in vol. xxviii, p. 366, to the effect that for a permanent success a cement plant must see within its own field, in which it is protected by the freight rates, enough demand to keep the plant running at a rate sufficient to pay its expenses. If this condition exists, the plant can make money enough during good times by helping fill the extra demand in the outer world and by raising prices at home to carry it over the dull periods. No dull time is in sight at present and there is no over production of buildings, in fact the demand cannot be supplied for some time to come. Just now, therefore, the cement plants ought every one of them to be making large dividends and one in operation ought to be good property, and this condition seems likely to continue for several years.

TIME AND PLACE OF THE N. A. C. U. CONVENTION.

What is the date of the next convention of the National Association of Cement Users, and at what place?

F. L. H., C. L. J., E. C. M., and Others.

Diligent inquiry has failed to bring the information desired from the president of the society, who has assumed charge of the matter. The latest information is to the effect that Chicago is doubtful about being able to meet his very strict requirements. A meeting of the board of directors is in session as this number of MUNICIPAL ENGINEERING goes to press and may make the announcement. If received in time it will be found in the last pages of this number.

CAPACITY AND OUTPUT OF CEMENT PLANTS.

According to my compilation from the "Directory of American Cement Industries" the output of cement for 1906 was 88,000,000 barrels. The geological survey reports output for 1905, 35,000,000. barrels. This shows an increase of 1906 over 1905 of 53,000,000 barrels.

Manufacturers have been reporting as behind in their orders from three to six weeks.

Reported stock on hand September 30, 1906, 2,300,000 barrels.

Where is the 53,000,000 barrels?

A MISSOURIAN.

The trouble is with the estimate of output for 1906. In the "Directory of American Cement Industries" there is no statement which will warrant the assumption that the output of cement for 1906 will be 88,000,000 barrels. In the October number of MUNICIPAL ENGINEERING, page 279, will be found an estimate of the probable output of Portland cement in 1906 of 47,000,000 barrels, from which it can be deduced that the editor's estimate of the rated capacity of the plants in operation for the year 1906 is but little more than 70,000,000 barrels. Our correspondent may have assumed rated capacity as output; he may have assumed too many days in the year as the running time of the full plant; and he

may have assumed too many plants as in operation for the full year. On the other hand the editor may have been too conservative in his estimate of output. It is not probable that the output will greatly exceed two-thirds the rated capacity of the mills, so that the editor's estimate of 47,000,000 barrels as the output for 1906 may be justified. Possibly this estimate is low but it is believed to be in error by a very small percentage of the total.

BOOK ON PLASTER MOLDS.

Referring to your inquiry, "Can you furnish a book that gives practical instruction in how to make plaster of Paris patterns and molds?" page 280 of M. E., October, 1906, I beg to refer you to a very good book written in the German language, "Anleitung zum Formen und Giessen," by Eduard Uhlenhuth. Third edition. 1892. A. Hartlebens Verlag, Vienna, Buda-Pesth and Leipzig.

CHARLES BECKER,
Milwaukee, Wis.

MANUFACTURERS OF WATERPROOFING COMPOUNDS.

Can you give us the names of any concerns who manufacture waterproofing compounds for Portland cement, or if not, can you give us any information regarding such waterproof compounds as may be on the market? We would be glad of any information which you can give us on the subject.

C. P. C.,
Boston, Mass.

There seem to be three general classes of waterproofing compounds for Portland cement on the market. One is a substance to be mixed with the cement, such as that made by the Sandusky Portland Cement Co., Sandusky, O., and the cement is then used in the usual manner. Another is a liquid to be used with water in mixing the mortar or concrete, such as that supplied by the Simpson Cement Stone Waterproofing Co., Kansas City, Mo. A third is a liquid applied with a brush to the completed work as paint would be applied, such as the product of the Standard Waterproofing Co., Indianapolis, Ind., or the Antihydrine Co., New Haven, Conn.

Doubtless there are several different chemicals used in each of these methods of application. Practically all of them are trade secrets, patents not being deemed advisable or not being obtained.

The Art Portland Cement Co., Kimmell, Ind., claim that their process of making white Portland cement has the effect also of adding considerable waterproofing quality.

Various methods of making concrete waterproof and various substances, which are said to have the quality, are described in the "Handbook for Cement Users" ($3).

MAKERS OF TRACTION ENGINES.

Please send me list of manufacturers of traction engines in the United States. I am particularly desirous of learning those putting out traction engines propelled by gasoline motors.

J. H. W., Helena, Cal.

There are many makers of traction engines in all parts of the country. On the Pacific coast may be named the Best Mfg. Co., San Leandro, Cal., who make engines for freighting purposes; Holt Mfg. Co., Stockton, Cal.

The Hart-Parr Co., Charles City, Ia., make traction engines using gasoline power.

The Buffalo Steam Roller Co., Buffalo, N. Y., make traction engines of 12 to 30 horsepower. The Kelly-Springfield Road Roller Co., Springfield, O., also make traction engines. Several of the manufacturers of agricultural machinery make traction engines, such as the J. I. Case Threshing Machine Co., Racine, Wis.; Port Huron Engine and Thresher Co., Port Huron, Mich.; Gaar, Scott & Co., Richmond, Ind., etc. Perhaps the firms named in the "Business Directory," published in each number of MUNICIPAL ENGINEERING, under the headings "Road Machinery" and "Road Rollers" can supply what is wanted.

MANUFACTURERS OF PORTLAND CEMENT.

Will you kindly give me the names and addresses of all the Portland cement companies now manufacturing cement in the United States? I would prefer a geographical list, and only those manufacturing Portland cement.

I also want to know the number of barrels each plant produces per day, and the capital stock of each plant.

H. M. R., Macon, Mo.

The Directory of American Cement Industries, ($5) is the best source of information regarding these questions. The following cement companies are reported as making cement at this time, but one address being given in case the company has several plants, and full information concerning them can be obtained from the "Directory":

Alabama: Alabama P. C. Co., Demopolis.

California: California P. C. Co., Colton; Pacific P. C. Co., Cement; Standard P. C. Co., Napa Junction.

Colorado: Portland Cement Co., Portland.

Georgia: Southern States P. C. Co., Rockmart.

Illinois: Chicago P. C. Co., Oglesby; German-American P. C. W., LaSalle; Universal P. C. Co., Chicago; Marquette C. M. Co., LaSalle.

Indiana: Art P. C. Co., Kimmell, just opening; Louisville C. Co., Speeds; United States C. Co., Bedford; Wabash C. Co., Stroh.

Kansas: Indian P. C. Co., Neodesha; Iola P. C. Co., Iola; Kansas P. C. Co., Iola; Western States P. C. Co., Independence.

Kentucky: Kosmos P. C. Co., Kosmosdale.

Michigan: Aetna P. C. Co., Fenton; Alpena P. C. Co., Alpena; Bronson div. C., C. & C. P. Co., Bronson; Burt P. C. Co., Bellevue; Egyptian P. C. Co., Fenton; Elk C. & L. Co., Elk Rapids; Great Northern P. C. Co., Marlborough; Hecla Co., W. Bay City; Newaygo P. C. Co., Newaygo; Omega P. C. Co., Jonesville; Peerless P. C. Co., Union City; Peninsular P. C. Co., Cement City; Wolverine P. C. Co., Coldwater; Wyandotte P. C. Co., Wyandotte.

Missouri: St. Louis P. C. Co., St. Louis.

New Jersey: Edison P. C. Co., New Village; Vulcanite P. C. Co., Vulcanite.

New York: Alsen's A. P. C. W., Alsen; Buffalo C. Co., Buffalo; Catskill C. Co., Cementon; Cayuga Lake C. Co., Ithaca; Cummings C. Co., Akron; Empire P. C. Co., Warners; Glens Falls P. C. Co., Glens Falls; Helderberg C. Co., Howe's Cave; Hudson P. C. Co., Hudson; Iroquois P. C. Co., Caledonia; Newman's Akron C. Co., Akron.

Ohio: Alma C. Co., Wellston; Buckeye P. C. Co., Bellefontaine; Castalia P. C. Co., Castalia; Diamond P. C. Co., Middle Branch; Ironton P. C. Co., Sandusky; Union P. C. Co., Rushsylvania.

Pennsylvania: Alpha P. C. Co., Easton; American C. Co., Philadelphia; Atlas P. C. Co., Coplay; Bonneville P. C. Co., Siegfried; Clinton C. Co., Pittsburg; Coplay C. M. Co., Coplay; Crescent P. C. Co., Wampum; Dexter P. C. Co., Nazareth; International C. Co., Elizabeth; Lawrence C. Co., Siegfried; Lehigh P. C. Co., Allentown; Nazareth C. Co., Nazareth; Northampton P. C. Co., Stockertown; Penn-Allen P. C. Co., Penn-Allen; Pennsylvania C. Co., Bath; Phoenix C. Co., Nazareth; Whitehall P. C. Co., Cementon.

South Dakota: Western P. C. Co., Yankton.

Utah: Portland C. Co. of Utah, Salt Lake City.

Virginia: Virginia P. C. Co., Frederick.

West Virginia: Buckhorn P. C. Co., Rowlesburg.

If this list is not complete, additions or subtractions will be made on receipt of information from reliable sources.

CITIES USING ROCK ASPHALT FOR PAVING.

How many cities are using rock asphalt in building streets? If you will give me a list of these cities, I will be greatly obliged. W. D. L.,
Louisville, Ky.

The following cities have used rock asphalt in streets in various forms: New York and Buffalo, N. Y.; Pittsburg, Pa.; Columbus and Cincinnati, O.; Indianapolis and Evansville, Ind.; Bowling Green and Louisville, Ky.; Memphis, Tenn.; Little Rock, Ark.; Birmingham, Ala. It is said that many Texas and Arkansas cities have used local asphaltic materials for making streets. Doubtless there are other cities who can report experience with this class of paving material.

LIGHTING

Gas From Peat—New York City Water and Light—Automatic Lighters for Street Gas Lamps—Municipal Ownership in Harlem, Ill.

Gas From Peat.

A gas factory, said to be different from anything in the United States, is being installed at Orlando, N. Y. Experiments made by Hon. J. M. Cheney and gas expert Paine in the manufacture of gas from peat have proven so successful that an entire new peat plant is being installed and gas from peat will be furnished the present gas customers, and a lighting

medium equal to the best coal gas that can be made is assured.

New York City Water and Light.

Commissioner Ellison, of the department of water supply, gas and electricity, New York city, says that half a billion gallons of water are used every day and this is constantly increasing.

Last year the revenue of the department was $10,065,000, while it spent $6,215,000. About $20,000,000 worth of improvements are being made, of which $5,250,000 is being spent for a high pressure fire system of mains which, when finished, will cover seventy-eight miles of streets and have 2,012 fire hydrants.

New pumping stations are being installed and machinery replaced. Most of the city water is pumped to distributing reservoirs, and this requires fifty-eight pumping stations. A sample of the work of pumping may be found at the Ridgewood stations, in Brooklyn, where the work of the engines each day is equivalent to pumping 480,000 tons of water 170 feet high.

Water is distributed through 2,000 miles of mains, from 6 to 60 inches in diameter. To these are attached 293,945 taps, 25,000 fire hydrants and 50,172 meters. One million one hundred and fifty thousand dollars is being spent for a 60-inch steel main in Brooklyn. In addition to patrols along the water sheds, we have the best equipped laboratory for analyzing water in the world. The analyses are systematically made every day to protect the public health. In Brooklyn about 70 per cent. of the water is naturally or artificially filtered, but in several years all of it will be filtered, as the system is being installed now at a cost of $12,000,000.

We shall soon have available 105,960,000,000 gallons of water from reservoirs now in use and soon to be in use. This vast supply is inadequate, and preparations are being made to duplicate our daily supply of 500,000,000 gallons, at a cost of between $200,000,000 and $300,000,000.

He also stated that it cost $3,500,000 for lighting the city for the year, but that $800,000 was saved on contracts. The city has 65,818 lights to illuminate 209,918 acres. These are equivalent to 24,000,000 candles. There are 13,987 arc lamps, 4,581 incandescent lamps and 52,957 gas lamps. On the outskirts are 4,183 naptha lamps, and in Tottenville 100 kerosene lamps have survived modern illumination. The city has 1,380 city buildings to be lighted, requiring 224,294 gas lights and 185,263 electric lights.

Commissioner Ellison says the history of lighting the city of New York began in 1821. "Up to that time New York was lighted by candle or oil lamps, many of which were maintained by citizens. In 1856 gas lamps were put in, and in 1882 electricity, but the system was crude at first. The last of the old-fashioned lamps will be done away with this year, and the streets will be illuminated by arc lights and mantle gas lamps."

Automatic Lighters for Street Gas Lamps.

In his last report, Albert Halstead, United States consul at Birmingham, England, states that an automatic gas controller has been patented and is now on sale in England, which, if in practical operation fulfills the claims made by its owners, might materially lessen the cost of public lighting in the municipalities of the United States. The controller is said to be adapted to any type of incandescent burner, to fit any lamp, and to be instantaneous in its lighting and extinguishing. The mechanism consists of a clock which can be so set as to light the gas each night and extinguish it each morning, so as to make an automatic variation of the time of lighting and extinguishing according to the calendar. In other words, by means of a chart, the street lights are turned on and off, lighted and extinguished, at a different moment each day throughout the year, according to the season. This, it is claimed, is an advantage over any controller now on the market, one adjustment a year being sufficient. They require no attention except winding once a week or a fortnight, and when once set do not have to be reset throughout the year. The gas can be turned off and on in the ordinary way, quite independent of the gas controller. This is important, as it might be necessary to turn off the gas for the renewal of the incandescent mantles.

These controllers are now on trial at Bath, and the engineer of the gas company there has informed the municipal gas department at Birmingham that so far as their experience goes it gives satisfactory results. The city of Birmingham proper has 13,860 street lights, and the district outside, which is supplied by the municipal gas department of Birmingham, has 7,108 street lights. Their caretaking costs $102,484 per annum. To equip these street lights with this gas controller would involve an expenditure of $153,061. The cost of operating, it is claimed, would be just one-half. The price of a controller now is $7.29.

Municipal Ownership Question in Harlem, Ill.

The village board of Harlem, Ill., has decided to abandon municipal ownership and operation and to grant franchises to "foreign" companies to operate the water plant and furnish electricity for lighting the streets. The board's action is in direct opposition to the belief of many of the residents of the village, who propose to fight the granting of the franchises.

STREETS AND PAVEMENTS

Ohio Bridge Companies—Bitulithic in Atlantic City—Rapid Transit in Brooklyn Paving Bids in Knoxville—Public Work in Washington.

Bridge Trust Companies and Ohio Law.

Judge Ogan Failing, of Ottawa, Ohio, found the Canton Bridge Company et al., charged with violating the Valentine anti-trust law, guilty, October 15, and fined each agent $500 and costs, and the corporations $50 and costs. Those fined were Harry Hammond, J. H. Swigart, Simon N. Frasier and William Cleveland, and the Canton Bridge Company, Mt. Vernon Bridge Company, Massillon Bridge Company, Bellefontaine Bridge Company and Champion Bridge Company.

The circuit court at Bellefontaine, Ohio, handed down a decision, October 22, which, in effect, ousts from the State of Ohio all the bridge companies that failed to surrender at the recent so-called bridge trust hearing. The Ohio companies deprived of their charters by the decision October 22 are the Variety Iron Works, of Cleveland; The Iron Substructure Co., of Columbus; The Columbus Bridge Co., of Columbus. The Pennsylvania Bridge Co., of Beaver Falls, Pa., was ordered from the state. John R. Cassidy, Wm. R. Nivan, and E. P. Chamberlain, all of Bellefontaine, were appointed trustees to wind up the business of the companies.

Bitulithic Victorious in Atlantic City, N. J.

The court of errors decided, October 14, that the contract awarded by the council of Atlantic City, N. J., for paving Atlantic avenue with asphalt was illegal in that the ordinance by which the contract was granted the Cleveland Paving Company was illegal. The contract is set aside and the Standard Bitulithic Company can now proceed with bitulithic paving on that avenue.

The contract for paving Atlantic avenue, Atlantic City, N. J., awarded to the Standard Bitulithic Company, October 8, is doubtless the largest paving contract ever awarded in the United States, the total bid for the work being $266,550. The contract was awarded by a vote of fifteen to one, and was immediately signed by Mayor Stoy. The street is 75 feet wide between curbs and four miles long, extending from the "Inlet" at the northern end of the island to the southern limits of the city. The contract does not include the pavement between the tracks, but it is anticipated that the street railway company, which is owned by the Pennsylvania Railway Company, will adopt bitulithic for its portion of the work, which is to be paved by separate contract with the railroad company. The contract price for the bitulithic pavement, including foundation, is $2.25 a sq. yd. and 55 cents a cu. yd. for excavation.

Public Work in Washington.

The report of D. E. McComb, superintendent of sewers in the District of Columbia, has been submitted to Major John Biddle, engineer commissioner. He describes the operations of the sewer division for the fiscal year ending June 30, 1906, and states that under the appropriation for cleaning and repairing sewers and basins, the following work was performed:

Cleaned—Main sewers, 10,360 feet; pipe sewers, 111,879 feet; catch basins, 56,884; catch basin outlets, 58; manholes flushed and cleaned, 4,882; gravel basins, 10; sumps, 8; street detritus removed, 7,151 cubic yards.

Repaired—Pipe sewers relaid (includes basin connections), 396 feet; basins reconstructed and repaired, 89; basins abandoned, 24; basin outlets repaired, 18; basin tops replaced (bluestone and artificial), 22; manholes constructed, 8; manholes repaired, 37; manholes abandoned, 10; cast iron covers replaced, 76; alley grates and frames replaced, 13; bulkheads constructed in sewers, 3; flushing basins repaired, 4; depressions over sewers filled, 48; total number of jobs performed, 938.

Cost of cleaning main sewers, $2,680.34; repairing main sewers, $6,766.29; cleaning pipe sewers, $2,940.56; repairing pipe sewers (includes basin connections), $1,843.98; cleaning catch basins, $10,469.13; manual flushing of sewers, $3,570.68; reconstructing basins and replacing basin tops, $2,985.18; abandoning basins, $104.72; constructing manholes, $406.97; adjusting and repairing manholes, $325.55; abandoning manholes, $20.63; replacing cast iron covers and alley grates and frames, $565.60; filling depressions over sewers, $352.74.

Length of sewers constructed in fiscal year 1906: Main sewers, 31,051 linear feet, 5,881 miles; pipe sewers, 52,072 linear feet, 9,862 miles. Total length of sewers constructed, 15,742 miles.

Total length of sewers on June 30, 1906: Main sewers, 109,093 miles; pipe sewers, 357,257 miles. Total, 484,350.

Cost of sewer system to June 30, 1905, $13,613,932.38; cost of sewers (exclusive of maintenance), 1905, $1,213,315.96. Total cost, $14,827,248.34.

In a recent summary given by H. B. F. MacFarland, chairman of the District Commissioners, of the needs of the District, which are called to the attention of Congress this winter, he mentioned two as illustrative of the expansion of the material interests of the city. The first was the extension of the sewer system to the suburbs, and the second was the need for the duplication of the aqueduct, which brings the water of the Potomac to Washington.

George A. Wallace, water registrar, has submitted to the District Commissioners his report for the year ending June 30, 1906, as well as his estimates for conducting the business of his department from June, 1907, to June, 1908. He says the general branch of the water department has shown a large increase over the previous year, keeping the force working to its utmost at all times, necessitating the assignment of inspectors to permanent office duties, thereby limiting the field force to such an extent as to greatly interfere with that branch of work.

Regarding leaks and wastes, Mr. Wallace says:

The leakage and wastage of water in the District of Columbia has assumed such large proportions that it is imperative to have as great a number of inspectors on house-to-house examinations as possible in order that it may be checked. Of the 151,875 inspections made during the year, 81,417 were of this class, and of this number 22,782 leaks and wastes were found in 18,549 premises, showing that there is a leakage and wastage of water in one out of about every five houses. This number does not include inspections made with reference to leaks which are reported, either orally or in writing, by parties interested. In this class of work a specially trained force of inspectors is detailed constantly, as the source of the leak is, in a great number of instances, not apparent from the point at which it shows, and, in fact, breaks in water pipes, flowing a full head stream, have been found which were indicated only by the flooding of some cellar perhaps one or two hundred feet from the break. These leaks are detected through the skill of the inspectors and the use of water 'phones, with which they are equipped.

When a waste of water is found the occupant, as the responsible party, is notified that unless immediate steps are taken to check such waste the water supply will be stopped and not again restored until the department is satisfied that such conditions will not again occur; it is seldom that such action has to be taken, as in the majority of instances a waste of water is allowed to run through the ignorance of the user of the law bearing on the subject.

Premises in which wastes are found are examined frequently by the inspectors to see that there is no recurrence of these conditions. Such inspection is especially necessary during the winter months, there being a general tendency to let water fixtures run to prevent freezing.

In his annual report to the secretary of war, General Mackenzie, chief of engineers to the army, recommends, among other things, that the entire water supply system of the District of Columbia, including the aqueduct from Great Falls, the distributing, receiving and Washington city reservoirs and the filtration plant be formally transferred to the jurisdiction of the commissioners of the District of Columbia. The affairs of the entire conduit system are now administered by the engineer corps of the army as the representatives of the general government, leaving to the municipal authorities simply the local distribution of the water from the filtration reservoir. This division of control and responsibility has never been entirely satisfactory to either party, it is declared, and has sometimes resulted in official embarrassment. The army engineers are perfectly willing to relinquish supervision over the aqueduct system, but they openly express their objection to the proposed surrender of the public parks to the local authorities. The matter will be taken up at the coming session of congress.

In the annual estimates which went forward October 16, the District Commissioners asked authority from congress to construct and operate a municipal asphalt block plant.

Assistant Engineer Commissioner Jay J. Morrow has estimated that an asphalt block plant can be constructed at a cost of $25,000, and equipped for another $25,000, and that it can be operated afterward with money from the annual appropriations for street and highway improvements and appropriations for asphalt and cement.

Rapid Transit Lines for Brooklyn.

The plan outlined by Bird S. Coler, president of the borough of Brooklyn, for a system of rapid transit subways for the boroughs of Richmond, Brooklyn and Manhattan, has been approved by the Rapid Transit Commission. The plan was approved by the Board of Estimate and Apportionment several months ago. The Board of Estimate is in receipt of a communication from Alexander E. Orr, president of the Rapid Transit Commission, in which he agrees with all of Mr. Coler's plan, except regarding the Broadway spur, which, he says, would overload the systems. The communication says, in part:

The line proposed would begin at Pelham Bay Park in the borough of the Bronx, following Westchester avenue to the Southern boulevard as an elevated road; thence as a subway west on 138th street to a point near the intersection of Lincoln avenue and East 138th street; thence under the Harlem river and Third avenue and the Bowery to the Battery. At a point near the intersection of the Bowery and Canal street a divergent branch is recommended to connect with the Manhattan bridge, and then passing over the Manhattan bridge and under Flatbush avenue to Fort Hamilton. Near the intersection of 38th street and Fourth avenue there would be another divergent branch extending under 40th street, New Utrecht avenue and other streets to a point in 86th street near its intersection with Bay 34th street, and from thence on an elevated road over 86th street and Stillwell avenue to Coney Island.

SEWER CONSTRUCTION AT KNOXVILLE, TENN.

Difficult reinforced concrete pipe laying.

Paving Bids in Knoxville, Tenn.

The city of Knoxville, Tenn., asked for bids, to be received September 22, for bitulithic, asphalt, vitrified brick or other approved materials, paving in districts Nos. 10, 11, 12, 13, 14, 16, 17 and 18. The records of the meeting of the city council showed that the first four districts passed the third reading on April 6, and the last three on July 20, but the ordinances creating these districts were never published. At the request of Mayor Heiskell, all of the unpublished ordinances were sent to him for his signature, but the minutes of the meetings of the city council had not been signed before by the mayor since he took the office, January 27, 1906, with the exception of three meetings when John P. Murphy acted as mayor pro tem. Paving contractors objected to signing the contracts because the ordinances creating these districts were not published. As a result, the opening of bids for the work was postponed until October 18, and the ordinances published in compliance with the law.

The bids opened at that date on eighteen districts were from the Southern Paving and Construction Co., at $2.12 a square yard for brick with cement filler, $2.17 with pitch filler, and $2.22 with asphalt filler, $3.00 for 3-inch wooden blocks and $1.97 for Bermudez asphalt; the Southern Bitulithic Co., at $2.27 for bitulithic on concrete base, and $2.15 on bituminous base; and the Barber Asphalt Co., at $2.00½ for Trinidad asphalt and $1.92 for Buena Vista asphalt. The total amount of the eighteen contracts ranges from about $260,000 for asphalt to $390,000 for wood n block.

ORGANIZATIONS AND INDIVIDUALS

Central States Water Works Association—Technical Meetings—Civil Service Examinations—Personal Notes.

Central States Water Works Association.

The tenth annual convention of the Central States Waterworks Association was held at Cincinnati, Ohio, September 25, 26 and 27. Owing to the legal interpretation of the Ohio Code, which does not permit the expense of delegates to conventions being borne by a municipality, a number of municipalities in Ohio were not represented by delegates. About 200 members and guests were present, however. Little was done the first day except the delivery of the usual addresses of welcome, and the reading of the report of the treasurer.

On the second day the session was opened by Ward Baldwin, consulting engineer of Cincinnati, who gave a detailed description of the performance of the two turbine generator sets installed in the tannery of the American Oak and Leather Co., of Cincinnati.

The new waterworks of Cincinnati were described in two papers—one by G. H. Benzenberg, acting chief engineer, who gave a description of old and new works, and one by E. G. Manahan, assistant engineer in charge of filtration, who described the purification works. The new works consist of an intake on the Ohio river, several miles above the city, a pumping plant, subsidiary reservoirs with a combined capacity of 350,000,000 gallons, coagulating basins and a mechanical filter plant. Instead of using mechanically operated rakes or compressed air in washing the mechanical filter plant, wash water will be forced through the gravel and sand at about 2 1-2 times the customary rate. It was stated that Mr. Ellms, chemist for the water commissioners, who originated the process, has found that this method gives a more thorough and uniform agitation than has been otherwise accomplished. Sulphate of iron and lime will be used for a coagulant. The suspended matter in the river water during more than half the days of the year ranges from 200 to 2,000. The bacterial average is as high as 20,000 per cu. cm. and at times runs above 100,000. Subsidence alone, it is expected, will remove from 40 to 80 per cent. of the suspended matter and an average of 50 per cent. of the bacteria, while of the remaining suspended matter and bacteria 50 to 90 per cent. will be removed in the coagulating basins. It is believed that filtration will complete the removal of the suspended matter and leave only about 1 per cent. of the original bacteria. A clear water basin, holding 20,000,000 gallons, is about completed. Concrete is being extensively used in the construction of the filters and the various buildings. The filter units, 28 in number, will be monolithic boxes of reinforced concrete 50x32 feet by about 11 feet deep. Electric power will be used for operating all the filter pumps, stirring machinery, and all valves more than 16 inches in diameter.

Two papers on the use of sulphate of iron and lime as a coagulant were read—one by J. W. Ellms, chemist of the new waterworks at Cincinnati, and one by W. A. Patton, who described the experience at a plant supplying Catlettsburg, Ky., and other nearby towns. L. M. Latta, general manager of the Akron Waterworks Co., at Akron, Ohio, read a paper on "Water Waste and Means for Its Prevention." The combined use of water meters and inspectors has resulted in a material increase in income, but has failed, thus far, to reduce appreciably the consumption per head.

The next meeting will be held at Wheeling, W. Va. Officers were elected as follows: President, Thomas R. Cook, Toledo, O.; vice-president at large, John Langan, Tipton, Ind.; secretary, W. A. Veach, Newark, O.; treasurer, A. W. Inman, Massillon, O.

Technical Meetings.

The fourth annual convention of the American Brotherhood of Cement Workers was held in Buffalo, N. Y., Septem-

ber 15, 16 and 17. About 100 delegates from different parts of the country were present. The sessions of the convention were devoted to a general discussion of the labor conditions throughout the country. An attempt will be made to organize cement workers in the different cities of the country. Officers were elected as follows: President and general organizer, Albert Tracy, New York city; vice-presidents, Martin Goellnitz, New York city; P. Molloy, Chicago; Thomas White, St. Louis; T. E. Keough, San Francisco; trustees, Dan O'Shea, East St. Louis, Ill.; Albert P. Molloy, Chicago. The next annual meeting will be held at Memphis, Tenn., on the second Tuesday in September, 1907.

The first annual convention of the American Gas Institute was held in Chicago, October 18 and 19. Officers were elected as follows: President, Walton Clark, Philadelphia; vice-presidents, C. F. Pritchard, Lynn, Mass., and Henry L. Doherty, New York city; secretary, Jas. W. Dunbar, New Albany.

At a meeting of the Western Pennsylvania Society of Engineers, October 10, the Pittsburg filtration plant above Aspinwall was visited by the members. Morris Knowles, superintendent of the bureau of filtration, stated that one-half of the plant will be completed before the winter sets in and the work is suspended until next spring. The big pumping station on the bank of the Allegheny river is but half built, but contains none of the machinery that will be required to operate the plant. The mains through the grounds are all laid and connections completed. About 18 or 19 of the filter beds, where the actual work of purifying the water is to take place, are under roof and enclosed with concrete. Superintendent Knowles predicts that 23 or 24 of the filter beds will be finished by the first of December. The finished plant will have 46 filter beds, each covering one acre of ground and with a daily capacity each of 3,000,000 gallons. All of the filter beds will not be in operation at the same time, however, as some of them will be out of service while being cleaned. The sedimentation basins, three in number, constitute one of the principal parts of the filtration system. The receiving basin, through which passes the raw water of the mains from the pumping station, is a smaller affair and is practically finished. The other two basins, one on each side of the receiving basin, are large reservoirs. The bottom and sides of one is almost finished with concrete, and work on it will be completed by the first of December. The ground is being excavated for the other big sedimentation basin, but the concrete sides and bottom can not be constructed until next year. The filtration system is divided into ten contracts.

The executive board of the Nebraska Cement Users' Association has chosen Grand Island, February 6, 7 and 8, 1907, as time and place of annual meeting. There will be a large exhibit room, containing about 9,000 square feet of floor space, and all machine men, both block machines and mixers, who care to exhibit are invited to write to W. F. Roney, Grand Island, or J. R. White, North Platte, secretary and treasurer, for terms on space. A large attendance is expected with many addresses from prominent men.

Civil Service Examinations.

The U. S. Civil Service Commission announces examinations at the usual places as follows:

For topographic draftsman, department of construction and engineering, Isthmus of Panama, at $100 or $125 a month on Nov. 7 and 8.

For 20 architectural draftsmen at $1,400 to $1,800; 38 junior architectural draftsmen at $840 to $1,200; 2 engineer draftsmen at $1,600 to $1,800; 5 electrical engineers and draftsmen at $1,200 to $1,600 and 5 heating and ventilating draftsmen at $1,200 to $1,600 a year in the Supervising Architect's office, Washington, on Nov. 20-22.

For junior architectural draftsman at $900 a year in the Bureau of Animal Industry on Nov. 20-22.

For laboratory assistant qualified in practical optics at $1,000 a year in the Bureau of Standards, on Nov. 14.

For mechanical draftsmen in the Engineer Department at Large at Wheeling, W. Va., and Chattanooga, Tenn., at $1,500 a year on Nov. 21.

Personal Notes.

Will P. Fowler has been appointed city engineer at Wabash, Ind.

Hon. M. A. Brouse, mayor of Kokomo, Ind., died October 2, of heart failure, superinduced by diphtheria and tonsilitis, aged 39 years.

S. W. Emerson has been appointed concrete engineer at Cleveland, O., a position created by the department of buildings of that city.

John McGaw Woodbury, street cleaning commissioner at New York city, resigned his position October 13, to take effect immediately.

S. Bent Russell, consulting engineer, St. Louis, Mo., recently made an investigation and report on the value of the Marion, O., water works plant.

Rudolph P. Miller, late chief of bureau of buildings, New York City, has opened an office as consulting engineer as 527 Fifth Ave., New York.

Lewis T. Haney, Asso. Mem. Am. Soc. C. E., has removed from Church and Utica aves., Brooklyn, N. Y., to Room 1008, 257 Broadway, New York city.

Hon. Charles A. Sneyder, mayor of Dayton, Ohio, was drowned October 24, while duck shooting in the Whitefish district, near Port Arthur, Ont.

W. A. Ham, formerly concrete engineer for the Tucker & Vinton Corporation, has accepted a position as concrete engineer of the General Fireproofing Co., of Youngstown, O., and New York city.

B. R. Whitney has been appointed constructing engineer in the engineering department, at Kansas City, Mo. This position was created in order to give City Engineer Harper an assistant in the field who will have responsible control of construction.

Charles W. Brooke and Frank B. McConnell have formed a partnership under the firm name of Brooke & McConnell, to conduct a business of advertising the products of engineering concerns, heretofore conducted by H. M. Baxter. Their headquarters are in the Lewis building, Pittsburg, Pa.

J. R. Worcester, E. E. Pettee and G. H. Brazer have formed a partnership under the firm name of J. R. Worcester & Co., consulting engineers, with offices at 79 Milk st., Boston, Mass. They give special attention to designing steel and reinforced concrete structures, and foundations of all kinds.

The personnel of the Reclamation Service has been changed as follows: Mr. Joseph Wright has been appointed engineer and assigned to Huntley Project, Mont.; Mr. D. G. Martin, engineer, formerly employed on Minidoka Project, has resigned from the service. The following have been appointed engineering aids and assigned as noted: Mr. Frank A. Banks, Lower Yellowstone Project; Wm. I. Boyd, Salt River Project; Roy H. Elsea, D. W. Ross, Boise, Idaho; W. A. Stebbins, Shoshone Project, Wyo.; Arthur J. Strong, Lower Yellowstone Project.

J. A. L. Waddell and Ira G. Hedrick, consulting engineers at Kansas City, Mo., will dissolve partnership December 31, 1906. Mr. Waddell will form a new partnership January 1, 1907, with John Lyle Harrington, under the firm name of Waddell & Harrington, and will engage in practically the same line of work, bridge and structural engineering. Mr. Hedrick will continue in bridge engineering, and will also engage in a more general engineering practice, including the engineering in connection with the promotion and development of new railways, interurban lines and other enterprises.

MACHINERY AND TRADE

New Power Plant of Marquette Cement Mfg. Co.

The Marquette cement works of LaSalle, Ill., opened its new plant recently. Souvenirs of the occasion, consisting of cigars wrapped in new dollar bills, were distributed to each of the company's 250 employes, who by their effort and interest have done much toward the success of this company.

The new building is 125 feet square, built of steel and concrete from ground to roof, equipped with 3,000 horsepower compound condensing engines, Stirling water-tube boilers, electric generators, heaters, purifiers, etc. Coal is delivered to the boilers by chutes from the Illinois Central railroad hoppers above, and the ashes are dropped direct from the automatic stokers to cars on the C., B. & Q. railroad tracks. The new power station will deliver the electric current to the cement plant, which will now be run entirely by electric power. The new power plant cost something over $200,000, and is pronounced by experts the most complete and economical in operation of any plant in the west.

This enterprising company has just commenced operations to double its present output of cement by the addition of a large number of furnaces, grinding machinery, etc., contracts for this work amounting to $250,000, having all been let, and work to be completed by March 1, 1907.

The New White Cement Plant of the The Art Portland Cement Co.

The plant of the Art Portland Cement Company is located on the west side of the village of Kimmell on the Baltimore and Ohio railroad in Noble county, Indiana, on its own siding adjoining the main lines of the railroad and Sparta Lake, which is the present source of the supply of marl. The company has several additional supplies of marl within a distance of one and one-half to two and one-half miles from the mill, which can be utilized in connection with Sparta Lake.

At this time the company has nearly

completed the erection of a plant with a single kiln, with due allowance in power and storage plant for early increase in capacity, and with provisions in the plant for the addition of the machinery necessary for this increase. The machinery now in the plant consists of the following:

MELVILLE M. SMITH,
Gen. Man. Art Portland Cement Co.,
Kimmel, Ind.

The dredge is on a boat 65 feet by 26 feet. It consists of a bucket elevator excavator with a capacity of one cubic yard a minute. The discharge is into a pug mill, thence to a stone separator attached thereto. Thence the marl passes to tanks from which it is pumped by compressed air through the marl pipe to the tanks in the mill. The Harris two-tank system is used for this purpose. In this system there are two tanks which operate alternately. Assuming one tank full and the other tank just emptied and under 100 pounds air pressure, a valve between them is opened and the air in the one tank forces the marl in the other tank through the marl pipe, the air compressor keeping up the pressure in the emptying tank to 100 pounds while exhausting the other. This exhaust fills the empty tank with marl from the boat tank simultaneously with the emptying of the other tank through the marl pipe. The air compressor is a 12 inch by 12 inch machine operated by a 50-horse power motor running at 750 revolutions per minute. The shafting and bucket excavator were supplied by the Jeffrey Manufacturing Co., Columbus, O. The marl pipe is carried on pontoons from the dredge to the dock at the plant, being lengthened or shortened according to the location of the dredge. At the dock it is connected to the pipe line which extends about 500 feet on shore to the marl tanks in the basement of the cement mill, the bottoms of which are about three feet above the level of the water in the lake.

The marl tanks are 13 feet deep and each 11 feet by 18 feet. A centrifugal pump lifts the marl to a measuring tank above the mixing pan, into which the marl is discharged with the amount of clay corresponding to each tank full. The pan is the standard 9 foot "dry pan." The clay is brought in by rail and handled by wheelbarrows.

From the mix pan the mixture of marl and clay drops into a tank 10 by 23 feet by 13 feet deep, from which it is pumped to a feeding tank over the wet tube mill.

E. E. HOYKENDORF,
Engineer Art Portland Cement Co.,
Kimmell, Ind.

This mill is 5 feet in diameter and 22 feet long with bevel gear drive operated by individual electric motor, which is the system of driving machinery used throughout the plant. From this mill the discharge is into two fine slurry tanks, each 13½ by 22 feet and 13 feet deep. The walls of the tanks are at the same time found-

ations for the machinery above. They are of concrete and were constructed very cheaply, the entire plant being underlaid with excellent gravel for making concrete. The constant pumping and the return of the overflow from the tube mill keep the various slurry tanks thoroughly mixed.

From the fine slurry tank a centrifugal pump lifts the slurry to a closed tank from which by a special process the material is treated and discharged into a bucket carrier of the Jeffrey Mfg. Co. design, which carries it to the feeding hopper over the end of the rotary kiln, of special design on account of the nature of the material.

The rotary kiln is 100 feet long and 7 feet in diameter and has a lining of fireclay blocks, 9 inches thick for 40 feet and 6 inches thick for 60 feet. The fuel used in the kiln is gas made from coal in a gas producer 13½ feet in diameter. Owing to the comparatively dry condition of the slurry the length of the kiln and the character of the fuel the kiln has a capacity of 225 to 250 barrels of clinker per day. The clinker can be carried on Jeffrey conveyors to storage in the yard or in the building or directly to the rotary cooler, which is 4 feet 8 inches in diameter and 40 feet long with natural draft.

From the cooler the clinker goes through an automatic weighing machine where gypsum is added and thence to the Kent Mill for first reduction, to which is attached a separator for returning coarse material to the Kent Mill, a standard installation by the Kent Mill Co., New York City.

Thence the clinker goes to the dry tube mill which is 5 feet in diameter and 22 feet long. Conveyors carry the finished cement to storage in 6 bins each 15 by 15 feet by 20 feet high, made of timber grain elevator construction, from which it is fed to packers. The storage and packing building is located between the company's switch and the railroad, the rest of the plant, except the machine shop, being on the other side of the switch tracks.

The equipment of the power house, which is a separate building, consists of the following principal items:

Two water tube high pressure safety boilers each of 200-horse power with steel chimney 4 feet in diameter and 130 feet high, air pump and condenser, pumps and feed water heater and purifier, a horizontal cross compound automatic 4-valve engine of 375 horse power, and a 300 k. w. generator at 400 volts and 187½ revolutions per minute, 3 phase 25 cycle alternating current. The lighting plant consists of a vertical engine and a 17½ k. w. direct current generator.

PLANT OF ART PORTLAND CEMENT CO., KIMMELL, IND., UNDER CONSTRUCTION.

The main building is a steel frame covered with cement plaster on wire reinforcement. The power plant is of hollow concrete blocks. The storage house is of frame elevator construction. All buildings have concrete foundations and magnesia roofing.

The product of the plant is the Parthenon brand, white Portland cement. From the description it will be seen that it is a true Portland cement. The whiteness of the cement and its waterproof qualities are procured by a special selection of materials, particularly of clay and a marl without iron, together with some special features in the manufacture, information about which is withheld by the company. Mr. Melville M. Smith is the chemist and general manager of the company and has devised the process by which the cement is given a whiter color which will fit it

for use in many places from which regular Portland cement has heretofore been excluded. Being non-staining it can be used for laying fine stone work and being practically white in color it can be applied to many artistic uses, thus admitting cement stone work of all classes from statuary to building blocks to competition with the best stone. Mr. E. E. Hoykendorf is the engineer of the company and the economy of construction and efficiency of the plant are mainly due to his efforts.

The company gives a guaranty that the Parthenon brand is a true Portland cement which will pass all the tests of the U. S. Government specifications, copy of which is printed on the guaranty, and will be equal in whiteness to the sample shown at time of purchase. Further particulars and samples of the cement can be obtained of the Art Portland Cement Co., Kimmell, Ind.

The Grand Rapids Meter Box.

The Grand Rapids meter box is designed for the economical setting of water meters in lawn or at curb. It is made of vitrified tile with a composition bottom and a cast iron ring attached to the tile so that the interior of the box is moisture proof. The cast iron cover clamps securely to the ring with a rubber gasket, making an air tight joint. Twenty inches below the top is a ledge forming a part of the tile and on this ledge is set a frost pad of wood in two parts hinged together and covered on the under side with heavy felt, thus dividing the box into two chambers and protecting the lower chamber in which the meter is set from all danger of frost. The water pipes come through holes near the bottom of the tile, are securely packed where they enter, and turn up to set the meter in the best possible position for reading.

The box is three feet deep and suited for use with any meter in common use, and for pipes laid at any depth. The Grand Rapids Water Meter Box Co., 574 Wealthy Ave., Grand Rapids, Mich., will furnish full details of this valuable addition to water works appliances.

Flexible and Expansion Pipe Joints.

Submerged pipes for water, oil and gas require a certain flexibility which can not be secured with entire safety unless some sort of flexible joint is used. Pipes across bridges also require flexible joints and joints which will take up the expansion and contraction due to changes in temperature and the shocks and changes caused by vibration. The applications of flexible joints in steam and water lines about pumps, engines, hoists, cars, etc., are innumerable.

Mr. A. L. Holmes, of Grand Rapids, Mich., has invented a very simple flange joint, which can be bolted together at any angle at which the ends of the pipe come together and can be moved in any direction without leaking. The joint is made in various styles and designs and of various materials for use in water, gas, steam, air and oil pipes, the flexibility of joints varying from about 12 degrees to 45 degrees, according to design and use. Several designs have cast iron ball with all other parts steel plate and are bolted together; another joint is made with melted lead poured in to hold the parts together; others use screw threads instead of bolts; others are adjustable, and one is a simple expansion joint. Mr. Holmes issues an illustrated catalogue showing all the various styles, with price lists and instructions for using, which he will send on application.

Universal Portland Cement.

On October 1st, 1906, the Universal Portland Cement Co., took over the plants and business of the Cement Department of the Illinois Steel Co., and will continue the manufacture of Universal Portland Cement of the same high quality as heretofore. Edward M. Hagar, who has for six years been manager of the Cement department of the Illinois Steel Co., is president of the Universal Portland Cement Co., with headquarters in The Rookery, Chicago. The board of directors consists of the following:

Judge E. H. Gary, chairman of board of directors, U. S. Steel Corporation; Mr. E. J. Buffington, president Illinois Steel Co.; Mr. A. C. Dinkey, president Carnegie Steel Co.; Mr. T. J. Hyman, secretary and treasurer Illinois Steel Co.; Mr. Edward M. Hagar, president Universal Portland Cement Co.

The present output of 6,500 barrels a day of Universal Portland Cement at South Chicago, Ill.,. and Buffington, Ind., is being increased by a new plant at Buffington with a capacity of 6,000 barrels a day and a plant at Universal, Pa., near Pittsburg, to have a capacity of 4,500 barrels a day of Universal Portland Cement. When the new plants are in operation in the summer of 1907, ,the total output of the Universal Portland Cement Co. will be over 17,000 barrels a day of Universal Portland Cement.

The cement manufactured in the new mills, as well as the old, will be made

from slag and limestone by the same special process and under the same supervision which has been successfully employed by the Illinois Steel Co. since May, 1900. In the manufacture of Universal Portland cement, the two raw materials, crushed limestone and chilled blast furnace slag, are first dried, then thoroughly ground together in proper proportions, and burned to a clinker in rotary kilns. This clinker is afterwards finely ground and the resulting product is a true Portland cement, its method of manufacture and chemical composition being strictly in accordance with the definitions of the most prominent cement authorities in the United States and Europe.

True Portland cement made from slag should not be confused with puzzolan or so-called "slag cements," which are simply mechanical mixtures of slag and slaked lime ground together without burning, the latter being suitable only for use under ground and in moist locations.

The remarkable increase in demand for Universal Portland cement, an evidence of its high quality, is shown by the following figures of production by years since first placed on the market:

In 1900, 32,443 barrels; in 1901, 164,316 barrels; in 1902, 318,710 barrels; in 1903, 462,930 barrels; in 1904, 473,294 barrels; in 1905, 1,735,343 barrels; in 1906, (estimated) 2,200,000 barrels.

The production of Universal Portland cement has shown a steadily increasing percentage of the production of the entire country and in 1905 exceeded the production of the United States in 1896. When the new mills are in operation, the output of the Universal Portland cement will exceed ten per cent. of that of the entire country.

Both the new plants will be driven entirely by electric power from generators connected to gas engines using blast furnace gases. The power will be transmitted ten miles to Buffington from South Chicago at 22,000 volts from two 2,000 k. w. generators located at the south works of the Illinois Steel Co., from which point the supply of slag will be obtained. For the plant at Universal, Pa., near North Bessemer, the power will be transmitted seven miles from two 2,000 k. w. gas-engine-generator units at the Carrie Furnaces, Homestead Works of the Carnegie Steel Co., which furnaces will also supply the slag.

The cost of the two new plants will be $3,000,000 and the equipment will be such as to make them modern and efficient in every way.

Contracts have been placed for 21 rotary kilns 7 feet 6 inches in diameter and 120 feet long, 47 tube mills, and for dryers, preliminary grinders, etc., these orders being the largest ever placed at any one time for cement making machinery.

The buildings at each of these cement plants consisting of raw material bins, dryer building, raw material mill, burner building, finishing mill, stock houses and miscellaneous buildings, such as machine shop, transformer station, office and laboratory, are being built entire of steel and concrete, the largest buildings being the stock houses, 600 feet long and 100 feet wide, giving a storage capacity at each plant of over 400,000 barrels of finished cement.

The constant use of Universal Portland cement for the last five years in all classes of cement work, such as sidewalks, floors, artificial stone, reinforced concrete, general engineering work, foundations, piers, dams, fire-proofing and general building construction, has given it a splendid reputation as a standard Portland of the highest quality.

Universal Portland cement is a true Portland of the highest grade, suitable for all purposes for which Portland cement is used; in other words, "A standard Portland for universal use." It is guaranteed by the makers to be fully equal for all classes of work to any other Portland cement manufactured in this country or abroad.

Garbage Reduction.

In a recent number of the Journal of the Massachusetts Association of Boards of Health, Dr. Charles V. Chapin, superintendent of health, Providence, R. I., gave the following description of a new garbage reduction apparatus at New Bedford, Mass.:

The works were designed and built by the American Extractor Co. of Providence. They were completed last summer and since then practically all the garbage of New Bedford has been disposed of there. The capacity of the works is sufficient for handling a great deal more garbage than is delivered. The most notable features of the plant, and those which distinguish it from other reduction works, are the general excellence of construction, and the contrivance for expressing the water from the digested garbage. The garbage is dumped on a concrete platform in a separate building where it is allowed to drain, and is shoveled once or twice and all the tin pans, stones, pieces of iron, etc., picked out, when it is finally thrown onto a conveyor which carries it automatically into the digesters. This part of the process might give rise to nuisance if the building was not well built and ventilated, and carefully looked after as it is in New Bedford. The digesters extend up two stories, are eight feet in diameter and made of two-inch manganese iron. The garbage is digested for a number of hours, and the grease which rises to the top is

forced over into tanks, where it is separated from the water, and is finally drawn off into barrels. The garbage, now boiled into a pulpy mass, called tankage, is drawn off through a valve from the bottom of the digester and passes through a peculiar press, which is continuous in its action. It is really a great worm, into one end of which the wet tankage falls and is gradually forced through by the motion of the worm, the water at the same time being expressed. A somewhat similar apparatus is used in paper mills, but has been much modified for this work on account of the heterogeneous character of garbage tankage. It was said that only 50 per cent. of moisture was left in the tankage, and it certainly appeared to be as dry as that. This is a most excellent result. The tankage then drops into a dryer on the ground floor, from which it comes out dry enough to be sold to the fertilizer manufacturers. The apparatus is constructed so as to be continuous throughout, and the material when once thrown onto the conveyor is not again exposed to the air until the dry tankage and the grease are discharged. The vapors are constantly drawn out of the apparatus and condensed with sufficient water to render them innocuous, and the gases are consumed in the fires. The machinery seems to be substantial and much care has been given to the details of construction. There is no reason why the works should not be operated without any nuisance, and they were so operated at the time of the writer's visit in November.

In the last annual report of the New Bedford board of health are the following paragraphs:

There never has been a time in the history of the city when the collection of garbage has been so thoroughly performed as during the year 1905. At the beginning of the year it was learned that outside parties were collecting this refuse material in defiance of the regulations pertaining thereto, but the strenuous methods enforced by the board speedily put an end to this violation of the law, and since then the work has been done alone by the parties who are employed by the New Bedford Extractor Company, and in a most thorough manner.

The disposal of garbage, by the "Wheelwright Process," which is employed by the New Bedford Extractor Company, has proven a signal success. The material has been quickly destroyed and in such a manner that no one could justly find fault. Experts from various cities who have examined the plant have spoken in the highest terms of praise of its success, while the absence of unpleasant odors during the process of destruction makes the plant an ideal one from a sanitary standpoint. The work of collecting and disposing of the city's garbage is performed under contract, the same figures which the city paid three years ago being agreed upon by the New Bedford Extractor Company. Before the time expires on this contract the citizens will appreciate the fact that a great saving has been made in thus placing the contract without loss to the city. The natural increase in population would warrant a much larger sum were any contract of this character to be made at the present time.

These statements are so favorable that they warrant further investigation of the system used. Information as to details will be furnished by the American Extractor Co., 601 Banigan Building, Providence, R. I.

Clark Meter Box and Connection.

H. W. Clark, 1518 Broadway, Mattoon, Ill., is meeting with much success in the introduction of his meter box, for, although new to the market it is now in use in about every state of the Union. He is now filling a large order for the boxes to be used in Washington, D. C., showing the approval of U. S. Government officials.

To make the construction of the box cheap and easy, Mr. Clark has invented a collapsible iron mold for making the boxes of concrete so that users can make their own boxes, adding the Clark cover and lid. The boxes can be made up at odd times with practically no cost for labor as a consequence, and will be cheaper and better than those of any other material.

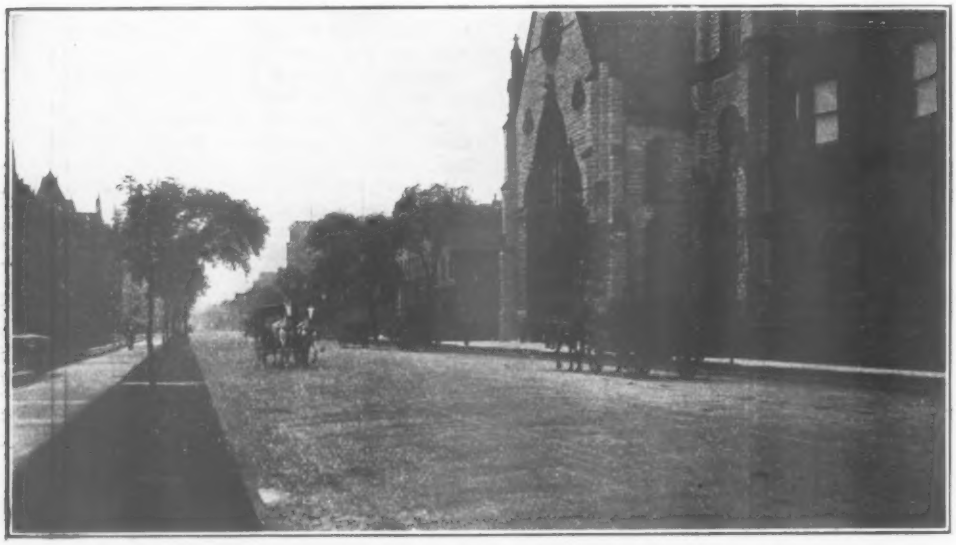
Another valuable appliance in Mr. Clark's list is the Teksagon meter coupling, which requires no gasket and secures a perfect joint. This coupling is furnished either straight or curved and will fit any regular meter spud. It is furnished in three sizes. Ask Mr. Clark for further particulars.

Tarvia, the New Dust Layer.

The use of tarvia, a kind of coal tar, as a remedy for the rapidly increasing dust nuisance which exists wherever automobiles have found their way, has been wide spread throughout the country during the past summer. Upwards of thirty towns and cities have made use of the material on their macadam roadways and it seems to have given universal satisfaction. In fact, in some places it has become so popular that the authorities have accepted it as a standard method of road improvement, and have decided to use it continuously in all road repairing work. South Orange, N. J., for instance, has passed an ordinance through its council to the effect that all macadam roads which are resurfaced hereafter shall be treated with tarvia. The authorities in Jackson, Tenn., and in Montclair, N. J., have expressed similar decisions in less formal manner and the result will be that all the macadam roadways in these places will eventually be made dustless by this method.

Tarvia is unlike the oils and various proprietary dust layers which are sprinkled on the road in order to make the dust too heavy to rise at the passage of the vehicles. Tarvia, on the contrary, gets at the causes of dust and prevents its forma-

tion. A coat of this material when spread on a roadway acts as a binder of the top dressing and makes the road thoroughly waterproof and frost proof. Water, instead of penetrating and disintegrating the top surface, runs off to the sides without penetrating and no mud is formed. As dust is nothing but dry mud it follows naturally that the wearing action of storms has little or no effect. Tarvia also helps the road to resist the pulverizing action of wheels and hoofs and is so successful in this respect that a single application will prevent the formation of dust for a period of a year or more, and the second application, requiring much less material, will last upwards of two years. Except for the fact that it will not stand



MICHIGAN BOULEVARD, CHICAGO, TREATED WITH TARVIA.

extremely heavy traffic, a tarviated road closely resembles asphalt, the surface being firm and smooth.

The U. S. Department of Agriculture, through its Office of Public Roads, has experimented with tarvia at Jackson, Tenn., with such success that it recommends this material in preference to oils of any kind, inasmuch as it is more permanent and satisfactory as a dust preventive.

The method of applying tarvia is shown very clearly in the photographs on pages 359 and 361, one of which, page 359, shows how the road is treated or painted with the material with a hose or street sweeper's brush. Another photograph, page 361, shows the completion of the process with the sweeping in of new screenings after the tarvia has been allowed to settle into the road for seven or eight hours. These photographs appear in an article describing the process of construction of roadway. The photographs of the roads at Rosemount and Chicago give some idea of the compact and clean appearance of the finished roadways. This road can be flushed with a hose without damage or swept like city streets. Sprinkling can be, and in fact invariably is, entirely omitted even under the severest tests of automobile traffic.

Trade Publications.

The Chicago Pneumatic Tool Co., Fisher Building, Chicago, Ill., send a booklet giving lists of users of their Franklin Air Compressor arranged alphabetically by countries if foreign and by states and by towns under the states. There is also a list of the plants having two or more of the machines installed.

The Gibson Company, Portland, Ore., have issued catalogue A of cinerary urns and concerning design and construction of mortuary crematories and columbaria.

The Cement Working Machinery Co., Detroit, Mich., have a new catalogue of their block machines and products.

Sturtevant blowers are shown in catalogue 135 of the B. F. Sturtevant Co., Boston, Mass.

Heraeus's Le Chatelier Pyrometer for measuring temperature nearly to 3,000 degrees is described in a pamphlet issued by Charles Engelhard, 41 Cortland Street, New York City, which contains some valuable information about high temperature.

Catalogue C of the Carson Trench Machine Co., Charlestown, Boston, Mass., illustrates the use of the Carson-Lidgerwood cableway for excavating and refilling all kinds of trenches.

Trade Notes.

ASPHALT.

Ardmore, I. T.—The Asphalt Brick Works have been organized here to manufacture asphalt brick, with officers as follows: President, O. T. Gregory; secretary, A. G. Edwards; treasurer, Ed Byrd.

Washington, D. C.—The District Commissioners, in their annual estimates, asked authority from Congress to construct and operate a municipal asphalt block plant.

114 pounds more than the maximum strength set by the government. The test is being made for the Gates interest, of which Mr. Clancy M. Lewis, of this city, is local representative.

Lincoln, Neb.—The Nebraska Material Co. has been organized here for the purpose of manufacturing and dealing in cement and concrete, by John A. Reichenbach, Frank Jouvenat, Lee Graham, Richard Wilkinson, and James H. Allen.

Port Colborne, Ont.—The by-law to exempt from taxation the property of the Great Lakes Portland C ment Co., Ltd., and the Canadian Portland Cement Co., Ltd., was carried, Oct. 17.

Chattanooga, Tenn.—The Dixie Portland Cement Co. has been incorporated under Tennessee laws and will construct a $1,000,000 cement plant at South Pittsburg. The officers of the company are: President, Geo. A. Nicholson, Iola, Kas.;

ROAD AT ROSEMONT, PA., TREATED WITH TARVIA.

BRICK.

Clinton, Mo.—J. D. Haugeburg, M. D. Lightfoot, and Geo. S. Holiday are organizing a company here for the manufacture of building and paving brick.

Dillsburg, Pa.—The Dillsburg Vitrified Brick & Tile Co. has been organized here to erect a plant for the manufacture of building and vitrified paving brick.

CEMENT.

Bellingham, Wash.—Special.—B. B. Lathbury, expert assayer of Philadelphia, Pa., has been making tests of the cement clay from Lummi Island. He says the material is excellent in quality for making cement and that there is no reason why the work of developing the beds and manufacturing the product should not proceed. In a twenty-four hour test made by Mr. Lathbury of the cement made from Lummi Island clay he made a most satisfactory showing. When put through the testing process the cement showed a straining power of 314 pounds per square inch, or

vice-president, A. B. Cockerell, Nevada, Mo.; treasurer, L. L. Northrup, Iola, Kas.; secretary, Richard Hardy, Detroit, Mich. This management operates four other large cement plants, as follows: The Kansas Portland Cement Co., Iola and Independence, Kas.; Indian Portland Cement Co., Neodosha, Kas.; Iowa Portland Cement Co., Mason City, Ia.

New York City.—Reuben Peckham, Chas. E. Kelly, and Chas. A. Taussig, 27 William st., have incorporated the Gypsum Mfg. Co., and will operate their gypsum mines and marble and granite quarries in northern New York.

Lexington, Ky.—The Patrick Cement Co. will establish a plant for the manufacture of cement at Stanton, Powell county, 50 miles from this city. A branch office will be maintained in this city.

Kittery, Me.—The Sandusky Portland Cement Co. has been incorporated here, with officers as follows: President, A. W. Knowles, Boston, Mass.; treasurer and clerk, J. W. Hawes, Kittery.

Fenton, Mich.—Lawson E. Becker, of

this city, has been appointed receiver for the Detroit Portland Cement Co., also of this city. This is the case in which the minority stockholders secured an injunction restraining the sale of the $200,000 plant by mortgage foreclosure. Judge Wisner approved the bonds of the receiver and granted a stay of proceedings pending an appeal to the supreme court. The present management will remain in control until the supreme court decides the case.

Palmyra, Va.—The Old Dominion Slate & Cement Co. has been incorporated.

Wolf Lake, Ind.—The Wolf Lake Portland Cement Co. has been incorporated to manufacture and sell Portland cement of all kinds. Chas. F. Knowlton, James F. Patterson and John E. Potter.

Iola, Kas.—The Union Portland Cement Co. has purchased land and will erect a plant near here at a cost of $3,500,000. The officers are: President, Governor John Mickey, of Nebraska; 1st vice-president and general manager, Richard C. Patterson, of Omaha; 2nd vice-president, Joab Mulvane, of Topeka; secretary and treasurer, John A. Wakefield, of Omaha. The headquarters of the company will be in Kansas City.

Bay City, Mich.—The Hecla Portland Cement Co. contemplates doubling its capacity next year by the construction of another unit.

Sturgeon Bay, Wis.—Investigations of the marl beds in the northern part of the county have been in progress for some time, with the result that a favorable report on the adaptability of the material for making cement will be made.

Alpena, Mich.—The United States Steel Co. has secured options on limestone lands near here for the purpose of having a supply for the Portland cement plant to be established at Gary, Ind.

Dallas, Tex.—The plant of the Iola Portland Cement Co. of Texas, located a few miles west of this city, will be enlarged and the capacity of the plant increased double.

Seattle, Wash.—The Pyramid Portland Cement Co. has been incorporated by James T. Lawler, John J. Stehle, and D. Carmody.

Seattle, Wash.—The Washington Portland Cement Co. has changed its place of business from this city to Anderson, Skagit county, where its plant is located.

Blue Rapids, Kas.—The Blue Rapids Gypsum Co. has completed a new mill and put it in operation.

Hays City, Kas.—A company has been organized and the cement deposits discovered in the ridge known as "Hog Back," will be manufactured and put on the market.

Baker City, Ore.—Special.—The Washington Portland Cement Co. met with a setback recently delaying them probably some months. The heavy rains in the Mount Baker district caused a flood that carried away the dam under construction and a part of the flumes. The loss is reported to be $20,000.

Bellingham, Wash.—Special.—The fact that aliens cannot hold title to property has handicapped the Balfour-Guthrie Co., of Seattle, and Evans, Coleman & Evans, of Vancouver, in getting their project started.

Duluth, Minn.—The Lake Superior Cement Co., recently organized, will commence work on its proposed plant in a short time.

CONCRETE BLOCKS.

Terre Haute, Ind.—The Modern Concrete Machine Co. has been incorporated by D. W. Henry, A. E. Harper, and W. T. Gleason.

St. Louis, Mo.—The Columbia Quarry Co. has been incorporated to operate lime kilns, cement factories and to manufacture concrete blocks, by Chas. H. Krause, Wm. A. Brandenburger, and M. Lovette.

Des Moines, Ia.—The Iowa Enamel Brick & Stone Co. has commenced the manufacture of cement products. The company controls the patents on machines making cement bricks, blocks, etc. The officers are: President, W. T. Langan; vice-president, D. M. Johnson; treasurer, Frederick Field; secretary, H. S. Chase.

Camden, N. J.—The South Jersey Cement & Brick Co. has been incorporated to deal in brick and cement, by Frederick Lange, Edward E. Jefferies, Howard B. Christman, Robert Mitchell, Alfred Page, and Alfred P. Page.

Granite City, Ill.—The Morris Hollow Concrete Block & Construction Co. has changed its name to the Morris Lumber & Construction Co.

Knoxville, Tenn.—The Concrete Block & Paving Co. has been incorporated by J. Q. A. West, W. A. Rolen, G. G. West, J. W. Cudgington, and J. W. Drummond.

Canton, O.—The Standard Clay Product Co. has been incorporated by A. H. Elliott, John Starkey, M. O. Sherer and others.

Rocky Ford, Colo.—The Cement Stone Co. has been incorporated by R. M. Pollock, C. H. Baldwin, and G. M. Hall.

South Bend, Ind.—Schuyler C. Lentz has associated himself with the R. Z. Snell Mfg. Co., of this city.

Rock Island, Ill.—The Tri-City Cement Products Co. has been incorporated to manufacture material, by Wm. Weimer, Albert W. Weimer, and Harry E. Brown.

New concrete block companies:

Hannaford, N. D.—Edland Bros.

Minneapolis, Minn.—The Flour City Cement Block & Machine Co.—John Nodolf, C. A. Huffman, Theodore H. Brown, Edward P. Elliott, Wm. N. Box.

Brazil, Ind.—The Clay Product Co.—H. H. Titsworth, J. E. Steaver, C. F. Shannon.

New York City.—The Concrete Products Co.—Wm. P. Horton, 181 W. 185th st.; Lewis E. Landon, 74 W. 127th st.; Willard L. Case, of Plainfield, N. J.

Boston, Mass.—Ajax Concrete Stone Co.—President, A. L. Jacobs; secretary, Geo. L. Galbraith; treasurer, F. E. French.

Spokane, Wash.—Spokane Hydraulic Pressed Stone Co.—P. E. Flannigan, H. T. Roberts, W. H. Broaddus, J. Myron Spaid, J. K. Brown, and J. A. McLean.

Seattle, Wash.—The Pyramid Portland Cement Co.—Jas. T. Lawler, John J. Stehle, D. Carmody.

Kramer, N. D.—C. R. Dowell.

Spencer, Ia.—L. L. Lague and Peter Kruse.

PURCHASE OF MACHINERY.

Modesto, Cal.—Special.—J. R. Baker is in the market for cement machinery and tools.

St. Marys Ferry, N. B.—Special.—Whitman Brewer advises us that he is in the market for stone crushers, concrete mixers, pile drivers, and bridge builder's outfit.

Indianola, Miss.—Special.—E. T. Morrison, engineer Southern Bridge Co., is in the market for cement and concrete ma-

chinery, and for rope tramways for handling concrete.

Omaha, Neb.—The Trussed Concrete Steel Co., of Detroit, Mich., has established a branch engineering and business office in the Range bldg., in this city.

Union City, Pa.—Special.—W. E. Goss, 10 4th ave., is in the market for a cement mixer and a cement brick machine.

New Haven, Conn.—Special.—G. F. Davis, 63 Division st., advises us that he is in the market for Universal mixers.

Pasadena, Cal.—Special.—McD. Lee Co., 14-16 E. Colorado st., is in the market for concrete block machinery, a stone crusher and asphalt mixing machinery.

Akron, O.—Special.—C. S. Hogarth, 399 Perkins st., is in the market for machinery and tools for concreting and cementing.

Adel, Ia.—Special.—J. E. Chamberlain advises us that he is in the market for cement drain tile machinery. Mr. Chamberlain saw a machine working at the Iowa State Fair and desires the address of the maker.

Nescopeck, Pa.—Special.—A. J. Harter is in the market for machinery and tools for making concrete paving and building blocks.

St. Helena, Cal.—Special.—John H. Wheeler advises us that he is in the market for a traction engine propelled by a gasoline motor, and for vineyard tools.

Columbus, Miss.—Special.—C. F. Sherrod is in the market for machinery and tools for making concrete blocks for building stores, warehouses and pavements.

Burlington, N. J.—Special.—T. E. Daniels desires names and addresses of reliable manufacturers of cement block machines for building purposes.

Leeds, N. D.—Special.—The Leeds Pressed Stone & Brick Co. is in the market for a gas engine and power tamper.

Creighton, Neb.—Special.—N. L. Raymond desires to purchase a gasoline engine, concrete mixers and cement workers' tools.

Fitzgerald, Ga.—Special.—C. W. Hayes advises us that he is in the market for a concrete mixer, fence post mold, and sewer pipe mold.

Frankfort, Ky.—Special.—B. F. Morrison is in the market for machinery and tools for all kinds of cement work and manufacturing cement blocks.

Early, Ia.—Special.—The Early Concrete Stone Co. is in the market for a cement post machine and rock crusher for small stone from ½ to 2 inches in diameter.

Racine, Wis.—Special.—M. H. White, 1317 N. Michigan st., desires information regarding block machines for making cemetery monuments.

Cando, N. D.—Special.—Geo. M. Crume is in the market for an up-to-date concrete machine and a brick machine for making clay brick.

Port Jervis, N. Y.—Special.—G. L. Barlow & Son are in the market for the best cement block machine made.

Grand Rapids, Mich.—Special. — A. Kuenzel, 50 Fremont st., advises us that he is in the market for a brick machine and concrete mixer.

Libertyville, Ill.—Special.—The Emmons Mercer Lumber Co. is in the market for cement work, brick and stone and coal handling machinery and tools.

Altoona, Pa.—Special.—C. B. Bartley & Sons, 200-214 7th ave., is in the market for a complete concrete plant.

Philadelphia, Pa.—Special. — Wm. Krause & Son, 1621-1623 N. 5th st., is in the market for cement machinery. The Monroe Portland Cement Co. was recently organized with B. S. Krause as president.

Enjis, Tex.—Special.—Hix McCanless, Box 413, is in the market for steam shovels, automatic sluice gates, wheel scrapers, etc., for levee work.

Chicago, Ill.—Special.—H. B. Farmer, 5950 Calumet ave., desires information regarding cement fence posts and how to make them.

Cassadaga, N. Y.—Special.—Paynes Sons advise us that they are in the market for block and brick machinery.

Plymouth, Wis.—Special.—J. A. Kuster is in the market for cement block and wood-working machines.

Utica, N. Y.—Special.—Kirk Camelo, supt. Utica Constr. Co., 639-41 Bleeker st., is in the market for concrete machinery and water-works and sewer machinery.

Leavenworth, Kas.—The department of justice will ask for the regular appropriation for the work at the federal penitentiary, including $20,000 for the purchase of a hard brick press for the manufacture of brick.

Cincinnati, O.—Special.—The Atlas Machine & Tool Co., 206-8 Ludlow st., is in the market for a concrete twisting machine.

Cranbrook, B. C.—Special.—George R. Leask & Co. is in the market for cement working machinery.

Kearny, Neb.—Special.—A. G. Hultman, 19th st. and Avenue F, is in the market for cement tools.

PURCHASE OF MATERIALS.

Libertyville, Ill.—Special.—The Emmons Mercer Lumber Co. is in the market for coal, cement and brick.

Pasadena, Cal.—Special.—E. J. Hart, 507 E. Orange Grove ave., is in the market for cement.

St. Louis, Mo.—Special.—M. B. Peugnet, 701 Chestnut st., is in the market for bricks, concrete, granitoid, lumber, steel, building and street making material.

Cando, N. D.—Special.—Geo. M. Crume desires to purchase cement.

Port Jervis, N. Y.—Special.—G. L. Barlow & Son desire to know how to test cement.

Early, Ia.—Special.—The Early Concrete Stone Co. is in the market for cement and reinforcing.

Frankfort, Ky.—Special.—B. F. Morrison desires to purchase cement.

Modesto, Cal.—Special.—J. R. Baker desires to purchase lime, cement and brick.

St. Marys Ferry, N. B.—Special.—Whitman Brewer advises us that he is in the market for cement, iron, steel, hard pine, etc.

Fitzgerad, Ga.—Special.—C. W. Hayes is in the market for cement.

Kingston, Pa.—Special.—Wm. J. Rivens, 55 Payne st., desires to purchase cement.

Creighton, Neb.—N. L. Raymond is in the market for cement and crushed stone.

Helena, Ark.—Special.—L. T. Hargraves desires to purchase cement, lime, etc.

Barto, Pa.—Special.—Wm. L. Stauffer is in the market for rock crushed into sand for making cement blocks, bricks, etc., and for cement.

Columbus, Miss.—Special.—C. F. Sherrod desires to purchase cement, lime and paint.

Petoskey, Mich.—Special.—Wm. Harrison desires names of firms west of the Mississippi river handling or manufacturing cement. He is in the market for

and desires to purchase in carload lots to ship into northern Dakota.

Nescopeck, Pa.—Special.—A. J. Harter is in the market for different kinds of cement.

New Haven, Conn.—Special.—G. F. Davis, 63 Division st., is in the market for cement and lime.

Pasadena, Cal.—Special.—McD. Lee Co.' 14 and 16 E. Colorado st., desires to purchase cement and marble dust.

Valley City, N. D.—Special.—The Rogers Lumber Co. is in the market for all kinds of cement.

Ft. Collins, Colo.—Special.—Benjamin F. Evans, 420 Garfield st., P. O. Box 836, advises us that he is interested in the purchase of cement, etc.

Union City, Pa.—Special.—W. E. Goss, 10 4th ave., is in the market for cement, lime and hard plaster.

Florence, Ala.—Special.—The Acme Lumber & Mfg. Co. is in the market for Portland and Louisville cements and wall plaster.

Indianola, Miss.—Special.—E. T. Morrison, engr. Southern Bridge Co., desires to purchase cement, pine lumber and reinforcing material for roofs of concrete.

Plymouth, Wis.—Special.—J. A. Kuster advises us that he is in the market for cement.

Utica, N. Y.—Special.—Kirk Camelo, supt. Utica Constr. Co., 639-41 Bleecker st., is in the market for cement and bridges.

New York City.—Special.—John H. Snyder, secretary Snyder Brothers, Inc., 47 Cedar st., advise us that they are in the market for marble dust or white crushed stone dust, delivered at Hoboken D. L. & W. yards. The company's object is to obtain either of the materials at prices low enough to permit of their use in the manufacture of cement blocks.

Port Chester, N. Y.—Special.—Frank C. Mertz desires the names of firms who make wood paving blocks.

Cassadaga, N. Y.—Special.—Paynes Sons are in the market for cement, lime and plaster.

Cranbrook, B. C.—Special.—George R. Leask & Co. is in the market for building materials.

Kearny, Neb.—Special.—A. G. Hultman, 19th st. and Avenue F, is in the market for cement.

LIGHT, HEAT AND POWER.

Mount Carmel, Ill.—The Mount Carmel Light & Water Co. has changed its location from Chicago to this city.

Chicago, Ill.—The Automatic Gas Light Co. has been incorporated by Richard W. Morrison, John M. Camelon, and Joseph E. Westley.

Augusta, Me.—The Lake Heat Engine Co. has been incorporated to manufacture and deal in heat, gas, air, electrical and steam engines, with officers as follows: President, M. Maddocks, Augusta; treasurer, H. L. Small, Augusta.

Chicago, Ill.—The Eigem Light Co. is being organized here to deal in electric supplies, by Shelley B. Neltnor, Edgar B. Fischer, and Chas. R. Rankin.

Chicago, Ill.—The Safety Electric Co. is being organized here to manufacture and deal in electrical supplies, by Frank N. Hillis, Harold A. Baum, and Alfred P. Miller.

Newark, N. J.—The Newark Arc Lamp Co. has been incorporated by Chas. L. Beck, Chas. O. Geyer, and F. C. Ferguson.

Jersey City, N. J.—The Dock Gas Engine Co. has been incorporated by John R. Turner, H. O. Coughlan, and B. Stafford Mantz.

Suits have been entered in the United States District Court at Pittsburg, Pa., against the St. Marys Incandescent Lamp Co., of St. Marys, Pa., alleging infringements on patents. One suit was filed by Arthur Malignani, of Undine, Italy, and the other by the General Electric Co., of Schenectady, N. Y. Both suits cover patents for exhausting the air from lamp globes.

MISCELLANEOUS.

Toronto, Ont.—The Harvard & Leach Paving Co. made an assignment, Oct. 5, for the benefit of their creditors.

Jersey City, N. J.—The Pierce Well Engineering & Supply Co. has been incorporated to construct water-works and drill artesian wells, by Chas. D. Pierce, Walter A. Spenser, and Louis Hulse. Hugh J. Massey is agent in charge.

Milwaukee, Wis.—The name of the Nicholas Sand & Gravel Co. has been changed to the Sarnow Sand & Gravel Co. Ed Steigerwald is president and Christ Sarnow, secretary.

Bound Brook, N. J.—The Trap Rock Crusher Co. has been organized to crush stone, do contracting business, etc., by Geo. J. Scholler, of North Plainfield, N. J.; Richard C. Chamberlain and Nelson L. Petty of Trenton.

Mattoon, Ill.—The Mattoon Waterworks and Reservoir Co. has been incorporated to operate a water-works system, by I. B. Craig, Wm. Moran, and J. L. Bennett.

Montgomery, Ala.—The Hercules Paving Co. has been incorporated to engage in paving and road construction work, by Herman Ruffi, John Craft, Ellen Quinn, Thos. J. Ford, J. P. McNamee, and others.

Bloomington, Ind.—Grading, preliminary to the erection of a creosoting plant here, will be done before it freezes this winter. The Indiana Creosoting Co. will erect a $70,000 plant.

Chicago, Ill.—On account of the rapidly increasing popularity of Franklin compressors manufactured by the Chicago Pneumatic Tool Company, notwithstanding the fact that extensive improvements and additions were made to their plant the current year, the business has grown beyond its capacity and they are now adding another 150 feet to their machine shop which will increase their present capacity from 55 to 70 compressors per month.

Columbubs, O.—The Jeffrey Manufacturing Company has established a new Canadian branch office in Montreal, Canada, at Lagauchetiere and Cote Streets.

Chicago, Ill.—The United States Pump & Power Co. has been incorporated by John M. Swanson, James A. Townsend and Perry A. Thompson.

Knoxville, Tenn.—Special.—W. C. Crozer, cy. engr., says bids were submitted October 18 for paving 101,827 sq. and 16,588 sq. yds. of street intersections with bitulithic, asphalt, vitrified brick and other improved material. The Southern Paving & Construction Co. bid $2.12 a sq. yd., including grading, for brick paving with cement fillter, $2.17 with pitch filler, and $2.22 with asphalt filler; $3 for 3-in. wood blocks; $1.97 for Bermudez asphalt. Southern Bitulithic Co., $2.27 a sq. yd. for bitulithic paving on 6-in. concrete base, and $2.15 on bituminous base. Barber Asphalt Paving Co., $2.00 1-2 a sq. yd. for Trinidad sheet asphalt paving and $1.92 for Buena Vista asphalt.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Suit against the Barber Asphalt Paving Company, to recover damages for the defective pavements discovered by the special committee appointed by common council to investigate the work, was begun at Trenton, N. J., October 18, by city solicitor Bird. There are eight suits to be brought against the company in supreme court.

CONTEMPLATED WORK.

East Liverpool, O.—Ida st. will be paved.

Pauls Valley, Ok.—Brick paving is proposed for the streets.

Estacada, Ore.—Council has authorized the macadamizing of Broadway street.

Raleigh, N. C.—Will vote in November on the issue of $300,000 road bonds.

Mitchell, S. D.—The street paving question is being considered by city council.

Fremont, Neb.—The question of issuing paving bonds will be voted on next spring.

Bay City, Mich.—The property owners on S. Van Buren st. have petitioned for paving.

Sycamore, Ill.—The property owners on Somonauk st. are in favor of asphalt paving.

Terre Haute, Ind.—Plans will be prepared for paving Crawford st. from 7th to 13th.

Chanute, Kas.—City council has decided to macadamize S. Lincoln st. next spring.

Grand Forks, N. D.—The council committee recommends creosoted wood blocks for paving.

Jeffersonville, Ind.—About 5 miles of paving is contemplated. Orland Hobbs, prest. B. P. W.

Edwardsville, Ill.—Ordinances have been passed providing for additional granitoid walks.

Houston, Texas.—The business men on Baker st. have petitioned city council to pave 3 blocks.

Auburn, Ia.—An ordinance has been passed requiring all wooden sidewalks to be replaced with cement.

Champaign, Ill.—City council has passed an ordinance to construct brick sidewalks on W. Clark st.

Peru, Ind.—City contemplates constructing 7,500 square yards of brick paving next spring. Wm. O'Day, cy. clk.

Cairo, Ill.—The construction of cement sidewalks on a large number of streets is contemplated. Mayor Parsons.

New Orleans, La.—Notice of intention to pave a number of streets has been published. T. W. Campbell, clk. council.

Tacoma, Wash.—A resolution has been passed providing for cement sidewalks on certain streets. L. W. Roys, cy. clk.

Minneapolis, Minn.—The construction of 182,508 feet of cement sidewalks is contemplated during 1907. Andrew Rinker, cy. engr.

Grand Forks, N. D.—About 60,000 sq. yds. of paving in the business districts is contemplated during 907.

Wichita, Kas.—Resolutions have been passed for paving Lawrence and Topeka aves with vitrified brick. R. N. Dorr, cy. clk.

Independence, Kas.—A resolution has been passed to pave, gutter and curb an alley. W. R. Pratt, Mayor; T. N. Sickels, cy. clk.

Monessen, Pa.—Special.—J. F. Irwin, boro engr., says ordinances have been passed and bids will be asked soon for 12,000 square yards of paving.

Columbia, S. C.—The question of street paving is being considered by city council, and wood block paving has been suggested for Main st.

Spokane, Wash.—Council has passed an ordinance providing for the construction of cement, brick or granite walks only within the city limits.

Emporia, Kas.—An ordinance has been passed to issue bonds for grading, paving and curbing 6th ave and Union st. O. B. Hardcastle, mayor; G. O. Mathewson, cy. clk.

Indianapolis, Ind.—Bitulithic macadam paving is proposed for 18th st. from Senate to Talbot aves. Final action has been taken on the resolution providing for bitu-mineral paving on Butler ave., Irvington.

Decatur, Ill.—City contemplates 6,276 square yards of brick paving and 4,215 feet of sandstone curbing on Oakland ave and 20 blocks of brick paving on E. Main, Packard and E. Condit sts. Albert Leach, cy. clk.; A. B. Alexander, cy. engr.

Suffolk, Va.—Town council is discussing the question of paving more streets. The bitulithic pavement constructed on Washington Square last spring has proven so satisfactory that the citizens on Main st. have asked council to pave that thoroughfare with that material.

Gettysburg, Pa.—Special.—S. A. Hammond is chairman of a committee appointed by the borough council to devise and submit a plan for paving the streets with improved and permanent paving material. Mr. Hammond desires to communicate with contractors for vitrified brick paving and other materials, regarding specifications and cost.

Mankato, Minn.—The property owners on 2d st., from Cherry to Walnut, have petitioned for brick paving.

Springfield, Ill.—The property owners on Lawrence ave., from 2d to Walnut sts., have petitioned for brick paving.

Ashland, Ky.—An ordinance and specifications have been adopted for paving an alley with vitrified brick. J. O. Mathewson, mayor.

St. Louis, Mo.—Plans have been completed for constructing a boulevard along the River des Peres, from Broadway to the Gravoir road.

Winston-Salem, N. C.—A committee has been appointed to make investigations preliminary to expending $200,000 for street improvements.

Kansas City, Mo.—An ordinance has been passed by city council providing for the construction of driveway to connect Kersey Coates Terrace and Penn Valley.

CONTRACTS TO BE LET.

Brazil, Ind.—Bids are asked until Nov. 12 for improving highways in Perry twp. Co comrs.

Sac City, Ia.—Bids are asked until Nov. 5 for constructing cement sidewalks. W. W. Cooper, clk.

Bedford, Ind.—Bids are asked until Nov. 7 for constructing gravel roads. Aslem Wood, chmn. co. comrs.

Crown Point, Ind.—Bids are asked until Nov. 5 for constructing gravel roads. Samuel A. Love, chmn. co. comrs.

Ottumwa, Ia.—Bids are asked until Nov. 5 for paving 4th st. with vitrified brick. W. H. O'Malley, chmn. st. com.

Madisonville, O.—Bids are asked until Dec. 24 for macadamizing Clason st. and Stewart Place. J. A. Conant, vil. clk.

Fort Worden, Wash.—Bids are asked until Nov. 10 for constructing roads, gutters and catch basins here. Chas. A. Clark, Q. M.

Petersburg, Ind.—Bids are asked until Nov. 5 for constructing rock roads. W. H. Gladish, chmn. co. comrs.; T. W. Basinger, co. audt.

Chehalis, Wash.—Bids are asked until Nov. 8 for covering about 6 miles of state road No. 5, with plank or gravel. N. H. A. Birley, chmn.

Columbus, Ind.—Bids are asked until Nov. 5 for constructing ½ mile of road in Hawcreek twp. Wm. O. Clark, chmn. co. comrs.; Wm. A. Morris, co. audt.

Johnstown, N. Y.—Bids are asked until Nov. 5 for 6,733 square yards of asphalt block paving and 3,142 feet of curbing on N. Market st. Frank Bogaski, cy. clk.

St. Louis, Mo.—Bids are asked until Nov. 2 for constructing bitulithic, vitrified brick and granite paving on certain streets. A. J. O'Reilly, chmn. B. P. I.

Harrisburg, Pa.—Sealed bids are asked until Nov. 9 for constructing 7,328 feet of state road, and until Nov. 10 for 4,002 feet of road. Joseph W. Hunter, state highway comr.

Alexandria, La.—Bids are asked until Nov. 6 for constructing concrete sidewalks and constructing curbing with cement or brick on upper sides of Carson st. E. F. Hunter, cy. clk.

Princeton, Ind.—Bids are asked until Nov. 7 for constructing 11 miles of gravel road, and until Dec. 1 for 1,190 feet of cement walks with concrete coping. Harry Embree, cy. audt.

Webb City, Mo.—Bids are asked until Nov. 5 for macadamizing streets, cement and brick sidewalks on certain streets, brick paving in an alley, and cement curb and gutter and stone curb. W. E. Smith, cy. engr.

Troy, N. Y.—Bids are asked until Nov. 9 for 4,700 square yards of vitrified brick paving on 6-in. concrete base and 4,000 square yards of vitrified brick paving on 9-in. concrete base, 3,800 lin. ft. granite curbing, etc. Jas. M. Riley, clk. bd. cont.

Mobile, Ala.—Bids are asked until Nov. 8 for constructing 40,670 square yards' of bitulithic paving; 11,080 square yards of treated wooden block paving with 5,799 lin. ft. of granite curbing; 17,164 lin. ft. cement combined curb and gutter. Stewart Brooks, prest. B. P. W.

Alexandria, La.—Bids are asked until Nov. 6 for constructing sidewalks on various streets. E. F. Hunter, cy. clk.

Wichita, Kas.—Bids are asked until Nov. 5 for paving Lawrence ave., from Douglas ave. to 1st st., with vitrified brick. R. N. Dorr, cy. clk.

Cincinnati, O.—Bids are asked until Nov. 12 for 11,400 sq. yds. of bitulithic paving and 2,250 sq. yds. of brick paving on Fairview ave.; also, for 17,750 sq. yds. of granite block paving on Clifton ave.; 12,600 cu. yds. grading; 8,250 lin. ft. granite curb; 2,960 yds. concrete. Chas. N. Danenhower, cy. engr.

New York City—Bids are asked until 11 a. m. Nov. 2 for repaving with wood block pavement on concrete foundation, Church st. and 33d, 1st and 7th aves. Joseph Bermel, prest. Boro of Queens. Bids are asked until Nov. 2 for furnishing and delivering Hudson river road gravel for parks and parkways in the Boro of Brooklyn. Park bd.

CONTRACTS AWARDED.

Washington, D. C.—Fairfax ave. will be graded and paved by R. A. Wallace.

Anniston, Ala.—The contract for paving Noble st. was awarded to the Southern Bitulithic Co.

Bucyrus, O.—The contract for paving Lucas st. with brick was awarded to Lewis Battefelt for $13,828.

Prescott, Ark.—R. S. O'Neal was awarded the contract for constructing 90,000 feet of concrete sidewalks.

Moline, Ill.—The McCarthy Construction Co. was awarded the contract for paving 18th st. with asphalt for $11,738.

Vandalia, Ill.—The contract for paving 4th, 5th and 6th sts. was awarded to Geo. C. Foulkes, of Terre Haute, for $10,300.

Chattanooga, Tenn.—The contract for paving McCallie ave with asphalt was awarded to the Southern Construction Co.

Evansville, Ind.—The contract for resurfacing 1st st. with brick was awarded to Stinchfield & Reichert at $1.13½ a sq. yd.

Denver, Colo.—The contract for resurfacing 16th st. from Larimer to Wazee with asphalt, was awarded to the Colorado Paving Co. for $6,737.30.

Hoboken, N. J.—The contract for constructing 1½ miles of stone road was awarded to Preakness Crushing Co., Preakness ave., Patterson, for $12,685.

Los Angeles, Cal.—The contract for paving W. Washington st. from Grand ave. to Figuera st. was awarded, Oct. 15, to the Barber Asphalt Paving Co.

Atlantic City, N. J.—The contract for improving the Hammond and Atsion road was awarded to C. W. Mathis & Co., of Tuckerton, for $30,508.

Davenport, Ia.—P. V. Clark was awarded the contract for macadam paving on Columbus ave at $1 a sq. yd., 38 cts. for grading, and $1.65 for brick gutters.

Indiana Harbor, Ind.—The contract for 38,000 sq. yds. of streets was awarded to Wm. Allborn & Co., 166 Russell st., Hammond, Ind., for $50,000. Macadam will be used.

St. Joseph, Mo.—Rackliffe & Gibson secured the contract for paving Duncan st. with brick, and the Phoenix Brick & Construction Co. the contract for brick paving on Lincoln st.

Philadelphia, Pa.—Contracts for street paving were awarded to the Barber Asphalt Paving Co. and the Filbert Paving & Construction Co. at prices ranging from $1.55 to $1.69 a sq. yd.

Jacksonville, Fla.—The contract for 182,606 sq. yds. of brick paving was awarded to John N. C. Stockton, at $1.60 a sq. yd., and for 47,484 sq. yds. of macadam paving to D. M. Baker at prices ranging from 66 2-3 to 90 cts. a sq. yd.

Superior, Wis.—The contract for paving Winter st. with sandstone blocks was awarded to Fielding & Shepley, of St. Paul, Minn., at $2.92½ a sq. yd. for pav-

ing; grading, 75 cts.; resetting curbing, 65 cts. a lin. ft.; oak headers, 50 cts a lin. ft.; excavating and refilling, $1.75 a cu. yd.

Oklahoma City.—The contract for paving 10th st. was awarded, Oct. 1, to The Cleveland Trinidad Paving Co., of Cleveland, O., for $37,614.50. Bermudez asphalt will be used. The Memphis Paving Co. bid $38,614.25, and the Barber Asphalt Paving Co. $35,358.50. The citizens had asked for Bermudez asphalt and council decided to award the contract for that material.

Kansas City, Mo.—Asphalt paving contracts have been awarded as follows: Cleveland Trinidad Paving Co.: Brooklyn st., $1.65 a sq. yd.; Indiana st., $1.70; Troost ave., $1.24. Parker-Washington Co.: Tracy st., $1.65; resurfacing McGee st. on macadam base already set, $1.35. Barber Asphalt Paving Co.: Warwick, $1.55; Lister, $1.60; Penn Valley Place, $1.55; Summit, $1.65.

Atlantic City, N. J.—Council has awarded to the Standard Bitulithic Co. of New York city a contract aggregating $266,550 for paving Atlantic ave. with bitulithic. The contract was awarded by a vote of 15 to 1, and was immediately signed by the mayor. Atlantic ave. is 75 feet wide between curbs, and 4 miles long. The question of improving Atlantic ave. had aroused the greatest interest and committees representing the city council, the Hotel Men's Association and the Atlantic Ave. Business Men's League examined street pavements throughout the country and communicated with the officials of cities not visited. The result of these investigations was the adoption of a unanimous report endorsing bitulithic and the sending of a petition to this effect to the city council. The adoption of bitulithic in Atlantic City is the direct result of a universal demand on the part of the people.

Cape May, N. J.—The contract for constructing 7 1-2 miles of streets was awarded to W. S. Shaw, Oct. 6.

Green Bay, Wis.—The contract for paving S. Broadway with macadam was awarded to J. K. Delaney, for $3,252.82.

Marion, O.—Contracts for constructing 5 miles of stone sidewalks have been awarded to John Kinsler and P. Drake & Sons.

Vicksburg, Miss.—The contract for paving China st. with brick was awarded to the Southern Paving Co., at $2.25 a sq. yd.

Atlanta, Ga.—The contract for repaving Peachtree st. with asphalt was warded, Oct. 15, to the Asphalt Paving Co. of Georgia, at $1.24 a sq. yd.

Chillicothe, Ill.—The contract for paving 3 blocks in the business district with brick was warded to A. D. Thompson, of Peoria, at $1.18 a sq. yd.

Newark, N. J.—The Standard Bitulithic Co. has been awarded the contract for paving Central ave., between High st. and the city line, with bitulithic.

Tuscola, Ill.—The contract for brick paving was awarded to Wm. Lough, of Arcola, Ill., as follows: Locust st., $14,730.90; Oak st., $1,987.15; Chestnut st., $2,947.20.

Camden, N. J.—The contract for constructing 3 1-3 miles of public road from Haddonfield to Coffins Corner was awarded, Oct. 10, to Edwin C. Humphreys, for $32,610.

Canton, Ill.—Hechard & Sons secured the contract for paving Avenue A with brick, for $11,352, and Savill & Garney the contracts for N. 2d and Martin aves. for $4,678.

Charleroi, Pa.—The contract for paving 2d, 7th, 8th and 9th sts. and Cherry and Peach alleys was awarded to the Charleroi Paving & Constr. Co., for $9,815.

Birmingham, Ala.—Contracts were awarded Oct. 3 as follows: Grading, macadamizing, curbing and gutter paving, Moore-Evans Constr. Co. and R. Blackburn, 219 S. 21st st., $15,903; grading, curbing and gutter paving, Southern Construction Co., $4,553; grading, macadamizing and gutters, C. M. Burkhalter, $2,712; sidewalk paving, R. Blackburn, $5,133.

Indianapolis, Ind.—Paving contracts were awarded Oct. 22, as follows: 23d st., from Central to College, asphalt with brick gutters and drain, Union Constr. Co., $2.75 a ft.; 15th st., asphalt and brick gutters, Marion Constr. Co., $2.71; alley, brick, $1.13; 20th st., brick paving and curbing, $3.34; alley, brick, $1.47, Capitol Constr. Co.; 3 alleys, brick, $1.77, $1.47 and $1.34, George McCray; Bird st., brick, $1.34, Indianapolis Constr. Co. Contracts were awarded October 26, as follows: Parker st., cement walks and curbing, Wm. H. Hall, $1.32; Bird st., from Michigan to North, brick, American Constr. Co., $1.92; cement walks on Market, M. Caldwell, 70 cts.; wooden block paving on Bone st., Marion Constr. Co., $2.69; brick paving on Bird st. and an alley, Capitol Paving Co., $1.35 and $1.37 respectively.

SEWERS.

Marissa, Ill.—The Marissa Sanitary Sewer Co. has been incorporated to build a sewer system, bby A. J. Meek and Robert Forsyth.

CONTEMPLATED WORK.

Crown Point, Ind.—A sewerage system is proposed.

Clarendon, Ark.—A sewerage system is contemplated.

Arlington Heights, O.—A sewerage system is contemplated.

Rolla, Mo.—Voted to issue bonds for sewer construction.

Litchfield, Ill.—Plans for a sewerage system have been adopted.

Forsyth, Mont.—Will vote Nov. 3 on the issue of $5,000 sewer bonds.

Brampton, Ont.—The installation of a sewage disposal plant is contemplated.

Cadillac, Mich.—The installation of a sewage disposal plant is contemplated.

Albert Lea, Minn.—Will vote Nov. 6 on the issue of bonds for a sewerage system.

San Francisco, Cal.—Bids will be received Nov. 5 for $1,087,200 sewer bonds.

Waterloo, Ia.—Plans for a combined sewer system for East Waterloo are being made.

St. Augustine, Fla.—Will vote Dec. 11 on the question of issuing $100,000 sewer bonds.

Norman, Ok.—Will vote on the issue of bonds for constructing a sewerage system.

Los Angeles, Cal.—A better system of storm drains for the business district is proposed.

Radford, Va.—Voted to issue $21,000 bonds for the construction of sewers in the East Ward.

Plainville, Conn.—The estimated cost of the proposed sewerage system is about $85,000.

Crowley, La.—Will vote Nov. 5 on the issue of bonds for constructing a sewerage system.

Henderson, Ky.—Will vote in November on the issue of $200,000 bonds for constructing sewers.

Freeport, L. I., N. Y.—The question of constructing a sewerage system is being considered.

Terre Haute, Ind.—City Eng. Schmidt has made plans and estimates for 2,650 ft. of sewer.

Urbana, O.—The question of constructing a sewage disposal plant is under consideration.

Radford, Va.—Voted to issue $21,000 bonds for the construction of sewer pipes in the East Ward.

Mexia, Tex.—The question of constructing a sewerage system is being discussed. I. Newman, cy. secy.

Danville, Ill.—The construction of 1 1-2 miles of sewer is contemplated here. W. H. Martin, cy. engr.

Galena, Kas.—The construction of pipe sewers at a cost of $14,000 is proposed. J. T. Botkin, cy. clk.

Mooresville, Ind.—Surveys for a complete sewerage system will be made by B. J. T. Jeup, of Indianapolis.

McMechen, W. Va.—Will vote on the question of issuing $20,000 bonds for constructing a sewerage system.

Willoughby, O.—Sealed bids are asked until Nov. 12 for the purchase of $3,500 sewer bonds. C. C. Jenkins, clk.

Cleveland, O.—A resolution has been passed to build a new sewer to take care of overflow water on W. 117th st.

Bemidji, Minn.—The construction of a septic tank for the sewerage system has been deferred until next year.

Jeffersonville, Ind.—Plans are being prepared for 10,000 ft. of 48-in. sewer. Orland Hobbs, prest. B. P. W.

Seattle, Wash.—Will vote in November on the issue of $1,436,000 for the extension of the sewerage system.

Shawnee, Ok.—Special.—Frank D. Brown, C. E., desires literature on the subject of drop manholes and concrete sewers.

Decatur, Ill.—Bids will be asked for soon for constructing 34,000 ft. of concrete main sewer. A. Leach, cy. clk.

Portland, Ind.—Plans and specifications for constructing a sewerage system will be made by Riggs & Sherman, of Toledo.

Cloquet, Minn.—A petition has been submitted to council asking for the construction of a sewer on Cloquet ave. this fall.

Richmond, Ky.—Will vote in November on the issue of $30,000 bonds for constructing a sewerage system. Clarence Woods, mayor.

Orangeburg, S. C.—A contract will be let the latter part of November or first of December for constructing a sewerage system.

Fort Worth, Tex.—L. G. Pritchard has applied to the city council of North Fort Worth for a franchise to install a sewerage system.

Knoxville, Tenn.—An ordinance is before the city council providing for the construction of 40 new laterals. W. C. Crozer, cy. engr.

Larned, Kas.—Special.—City council has engaged H. A. Rowland, of McPherson, Kas., to draw plans and specifications for a sanitary sewerage system.

Cuyahoga, O.—The estimated cost of a sewerage system is $75,000. The question of constructing the system will be voted on Nov. 6.

Takoma Park, Md.—The question of constructing reciprocal sewers between this town and the District of Columbia is being discussed. Ben G. Davis, town clk.

Indianapolis, Ind.—A resolution has been adopted providing for the construction of a local sewer in Washington boulevard, between Fall Creek and 34th st.

Little Rock, Ark.—The construction of a sewerage system at a cost of $450,000 and rebuilding a sewer at a cost of $100,000 is contemplated. E. A. Kingsley, cy. engr.

Salem, O.—Plans and specifications have been submitted for the proposed sewage disposal plant. The estimated cost is $33,000. The plans have been referred to the city engineer.

St. Mary's, O.—Bids will be received about Jan. 30 for constructing a sewer system, 14 miles long, with 153 manholes, 68 flush tanks, 20 drop manholes, 1 pump well, 1 pump reservoir, etc. F. W. Keuthan, cy. engr.

Waterville, Wash.—Special.—Mayor M. B. Howe desires to correspond with contractors and manufacturers regarding the construction of a sewerage system. He desires special information regarding a system of settling tanks.

Indianapolis, Ind.—Plans will be filed about Nov. 1 for the proposed big sewer in North Indianapolis. As soon as these plans are completed work on the plans for the proposed main sewer from Brightwood to Fall Creek will begin.

Binghamton, N. Y.—Common council has passed a resolution for the construction of the 4th ward trunk sewer. The plans provide for an open drain from Riverside Drive to the river, and for a septic tank. The plans will be sent to the state bd. of health for its approval.

Louisville, Ky.—Messrs. J. B. F. Breed, Samuel M. Gray and Harrison P. Eddy have submitted their report on the proposed sewerage system for this city. The sewer commission selected the first of three systems submitted, which provides for 60 miles of sewers, at a cost of $4,000,000.

Princeton, Ind.—A vitrified tile sewerage system is contemplated, requiring 2,102 ft. 6-in., 47,225 ft. 8-in., 10,850 ft. 10-in., 3,025 ft., 12-in. and 1,750 ft. 18-in. tile sewers, 174 c. i. manholes, 15 c. i. drop manholes, 10 flush tanks, 6 syphon chambers and 2 septic tanks. Chas. W. Benton, cy. clk.

Atlantic City, N. J.—The Board of Trade approves the proposed storm drainage system of J. W. Hackney, cy. engr. His plan embodies the digging of a canal 10 ft. wide and lined on the bottom and sides with concrete, which would extend from Gardner's Canal to Chelsea. Into this storm water drains from the cross streets would empty. City council passed an ordinance Oct. 22 to construct the system, and to retain a consulting engineer in the preparation of specifications.

Providence, R. I.—Sewers will be constructed here at a cost of $100,000. Otis F. Clapp, cy. engr.

Elmira, N. Y.—City council has decided to build sewers on S. Main, Mount Zoar, W. 4th and Washington sts. Frederick Leach, cy. engr.

CONTRACTS TO BE LET.

Virginia, Minn.—Bids are asked until Nov. 6 for constructing a sewer in District No. 3 F. Council.

Barberton, O.—Bids are asked until

Nov. 5 for constructing a sewer on 8th st. Geo. Davis, cy. clk.

Eatonton, Ga.—Bids are asked until Dec. 1 for constructing a sewerage system. H. C. Walker, secy.-treas.

Cleveland Heights, O.—Bids are asked until Nov. 6 for constructing 6 or more sewers. W. G. Phare, vil. clk.

Syracuse, N. Y.—Bids are asked until Jan. 2 for constructing a sewer system in Elmwood Dist. H. H. Brewster, engr.

Washington, D. C.—Bids are asked until Dec. 12 for completing the Panama canal. Chmn. Shonts, of Isthmian Canal Comn.

Mt. Healthy, O.—Bids are asked until Nov. 2 for constructing a concrete box culvert on Compton road. W. H. Blair, prest. co. comrs.

Cincinnati, O.—Bids are asked until Nov. 7 for constructing combined sewers and drains in Forest ave., Bond Hill. M. J. Keefe, clk. B. P. S.

Fairbury, Neb.—Bids are asked until Nov. 17 for constructing 6,400 lin. ft. of 8-in. lateral sewers for Dist. No. 7. W. W. Watson, cy. engr.

Los Angeles, Cal.—Sealed bids are asked until Nov. 19 for constructing and completing the proposed outfall sewer. Horace B. Ferris, secy. B. P. W.

Bainbridge, Ga.—Sealed bids are asked until Nov. 8 for constructing 8 or 9 miles of pipe sewers, with manholes, flush tanks, etc. E. A. Wimberly, cy. clk.

Dawson, Ga.—Bids are asked until Nov. 6 for constructing a sanitary sewer system, 8 miles in length. J. B. McGrary, engr., Atlanta; R. E. Bell, cy. clk.

Greenville, Ala.—Sealed bids are asked until Nov. 5 for constructing 3 to 4 miles of pipe sewers, with manholes and flush tanks. Thos. W. Peagler, cy. clk.

Perth Amboy, N. J.—Bids are asked until Nov. 7 for constructing a sub-drainage system at the U. S. postoffice and custom house here. Jas. Knox Taylor, supvr. arch., Washington, D. C.

Mobile, Ala.—Bids are asked until Nov. 8 for constructing 160 lin. ft. reinforced concrete culverts, 22,000 lin. ft. 10 to 30-in. pipe sewers; 10,000 lin. ft. pipe sewers, 6-in. house connections, with manholes, inlets, etc. Stewart Brooks, prest. B. P. W.

Boston, Mass.—Bids are asked until Nov. 9 for constructing in rock and earth tunnel, section 85, of the high level sewer, South Metropolitan system, in Brighton, consisting of the following: 6,350 ft. 69x72-in. sewer; 300 cu. yds. Portland brick masonry; 7,000 cu. yds. concrete masonry in tunnel. Henry H. Sprague, chmn. Met. water and sewerage comn.

Marion, Ind.—Bids are asked until 9:30 a. m., Nov. 2, for constructing a sewer. John O. Wilson, clk. B. P. W.

Baltimore, Md.—Bids are asked until Nov. 7 for constructing outfall sewer sections 1 and 2. Peter Leary, Jr., chmn. bd. awards.

Brookville, Ind.—Bids are asked until Nov. 5 for constructing a sewer from the county jail to the main sewer. Chas. A. Miller, co. audt.

Grand Haven, Mich.—Bids are asked until Nov. 7 for constructing 12 miles of brick, concrete and pipe sewers. Lewis A. Gorham, cy. clk.

Merchantville, N. J.—Bids are asked until Nov. 10 for constructing a sanitary sewerage system and sewage disposal plant. A. W. MacCallum, chmn. sewerage comn.

Decatur, Ill.—Bids are asked until Nov. 3 for constructing 3,148 ft. 48-in. and 1,470 ft., 42-in. concrete sewers, and 6 miles of laterals. A. B. Alexander, cy. engr.

Washington, D. C.—The contract for constructing sewers in 7th st., S. W., between E and G sts., was awarded to E. G. Gummel, for $4,772.

Central City, Colo.—Jordan & Co. was awarded the contract for constructing a sewer in McMilan st., from Ravine to Rohs sts., for $1,500.

Lake City, S. C.—The contract for constructing storm sewers was awarded to the Southern Construction Co., of Norfolk, Va., for $28,000.

South Omaha, Neb.—The contract for constructing the South Omaha relief main sewer was awarded, Oct. 8, to R. L. Kenny & Co., for $61,509.

Beatrice, Neb.—The contract for constructing new sewers in dists. 7, 8, 9 and 10 was awarded, Oct. 12, to Rackliffe & Gibson, of St. Joseph, Mo., for $3,683.71.

Atchison, Kas.—The contract for constructing a sewerage system in Challis Addition was awarded to the Boyd Const. Co., of Kansas City, for $23,987.54.

Cortland, N. Y.—Contracts for building 2,940 ft. of sewers on Homer ave. and 12,000 ft. on N. Main st. were awarded to James Grant, 107 Homer ave., for $5,992.

Albany, N. Y.—Sewer contracts were awarded Oct. 16 as follows: Swan st., Edward F. Dillon, $1,794.75; Prospect Place, John Doyle, $931.50; Washington ave., John Doyle, $1,400.25; Clinton st., John Doyle, $1,360.17.

Fairbury, Neb.—Special.—W. W. Watson, cy. engr., says council awarded a contract Oct. 16 for 1,792 ft. of sewer in dist. No. 2 to A. A. Lang, of University Place, for $1,418.

Baltimore, Md.—The contract for constructing sanitary sewers in Walbrook, under contract No. 1, was awarded to M. A. Talbott & Co., of Logansport, Ind., for $33,231. The contract for constructing building and laboratory for sewage disposal plant, contract No. 1, was awarded to Wm. Kirkpatrick, of Baltimore, for $3,750; constructing testing plant, contract No. 2, Malcolm W. Hill Co., 405 Courtland st., Baltimore, $6,930.

Evansville, Ind.—Contracts for constructing sewers were awarded, October 15, to Newman & Vineyard and James Meguair.

Chattanooga, Tenn.—The contract for constructing a sewer on 11th st. was awarded to Guild & Co., Oct. 16, for $5,270.10.

Clinton, Ind.—The contract for constructing a sewerage system was awarded to Jesse Robertson, of Terre Haute, for $25,000.

Cisco, Ill.—The contract for building a drainage system here was awarded to H. S. Walter, of Meldon, Ill., for $14,267.

Cartago, Costa Rica—The contract for constructing a sewerage system here was awarded to Nicolas Chavarria, for $65,-100.

Milledgeville, Ga.—The contract for constructing a sewerage system was awarded to Howard Neely, of Marietta, Ga., for $18,194.

CONTRACTS AWARDED.

Niagara Falls, N. Y.—Shepard & Co. secured the contract for sewer work for $6,600.

Dallas, Tex.—C. W. Olcott has been awarded contracts for constructing several sewers.

Woonsocket, R. I.—Napoleon Bouvier

& Co. secured the contract for constructing sewers.

Chisholm, Minn.—The contract for building a sewer on Hemlock st. was awarded to Jas. Dowling.

Portsmouth, O.—Monroe & Son secured the contract for building a sewer in Boundary st. for $1,146.09.

North Platte, Neb.—Conrad Walker was awarded the contract for constructing a sewer in district N, for $1,872.90.

Yankton, S. D.—The contract for constructing sewers was awarded to August Goetz, for $12,000.

Sunman, Ind.—The contract for constructing a sewerage system was awarded to Pulse & Porter, of Greensburg, for about $6,000.

Chillcothe, O.—The contract for constructing the Henry Creek reinforced concrete sewer was awarded to Jardine, Brewer & Tomlinson.

Rapid City, S. D.—The contract for constructing a sanitary sewerage system was awarded to McConnell & Sampson, of Sioux Falls, S. D., for $28,980.

WATER WORKS.

Houston, Tex.—This city assumed control of the water plant Oct. 1.

East Liverpool, O.—This city has received a bid of $600,000 for the municipal water plant, but refused it. The plant is valued at $1,000,000.

CONTEMPLATED WORK.

Swea City, Ia.—The waterworks system will be extended.

Mishawaka, Ind.—Pure water is desired for this city.

Peoria, Ill.—The water mains are to be extended to the Barrett plant.

Houston, Tex.—This city will expend $100,000 in extending the water mains.

Edgar, Neb.—Council has authorized the laying of 3,000 ft. of water mains.

New Brunswick, N. J.—The question of a filtration plant is being discussed.

Fairbury, Ill.—Council has decided to expend $6,000 for waterworks improvements.

Cedar Rapids, Ia.—The water commissioners urge the installation of water meters.

Mt. Pleasant, Mich.—Voted to issue $20,000 bonds for improving the waterworks system.

Wilkes-Barre, Pa.—Council is investigating the question of a municipal waterworks plant.

Woodland, Cal.—Voted to issue bonds for the extension of the waterworks and sewerage system.

Bedford, Ind.—Council has decided to improve the waterworks plant and install new equipments.

Concordia, Kas.—Resolutions have been passed for enlarging and extending the waterworks system.

Akron, O.—Will vote Dec. 17 on the issue of $200,000 bonds for erecting a municipal waterworks plant.

North Platte, Neb.—Will vote Nov. 6 on the issue of $90,000 bonds for the purchase of the water plant.

Carthage, N. Y.—The village trustees have appropriated $5,000 with which to begin surveying for waterworks.

North Yakima, Wash.—Will vote Dec. 4 on the question of building and operating a municipal waterworks system.

Birmingham, Ala.—The advisability of this city owning and controlling the water supply is under consideration.

Philadelphia, Pa.—An ordinance has been passed to lay water mains on a number of streets. John Weaver, mayor.

Collins, Miss.—An ordinance has been passed to issue $10,000 to enlarge and improve the city waterworks plant.

Crowley, La.—Will vote Nov. 4 on the issue of $100,000 bonds for the extension of the works, electric lights, etc.

East Liverpool, O.—Will vote in November on the issue of $90,000 bonds for the improvement of the waterworks system.

Lincoln, Neb.—Will vote Dec. 11 on the issue of $12,000 bonds for extending the water mains and improving the light plant.

Versailles, Ky.—Plans and specifications for a new waterworks and sewerage system will be made by Riggs & Sherman, of Toledo.

Battle Creek, Mich.—An ordinance has been passed providing for the issue of $250,000 bonds for building a waterworks plant at Verona Wells.

Helena, Mont.—Will vote Nov. 26 on the issue of $600,000 bonds for bringing in McClellan creek in furtherance of a municipal waterworks system.

Wellington, Kas.—Special.—O. T. Reece, cy. engr., says that this city voted, Oct. 9, to issue $30,000 for improvements to the water and light systems.

The question of issuing waterworks bonds has been favorably voted on at the following places: Rolla, Mo.; Billings, Mont.; Tecumseh, Ok.; Poteau, I. T.

The question of issuing bonds for the construction of waterworks will be voted on at the following places: Forsyth, Mont., Nov. 3; West Salem, Wis., Nov. 6; Enterprise, Ore.

Tacoma, Wash.—Ordinances have been passed providing for the construction of 6-in. wooden water mains, hydrants, gates, tees, etc. Geo. P. Wright, mayor; L. W. Roys, cy. clk.

Wichita, Kas.—Will vote Nov. 6 on the issue of $500,000 bonds for the purchase or construction of a waterworks system, to be owned and operated by the city. Findlay Ross, mayor.

East Orange, N. J.—A filtration plant for the water supply of this city will be necessary at a time not very far distant, according to Rudolph Hering, const. engr., of New York city.

Cincinnati, O.—Local press reports state that this city will probably quit selling water meters to water consumers, and permit them to purchase them direct from the meter manufacturers.

Moosemin, Sask.—Special.—A waterworks system is to be installed here, for which 6,000 ft. of water mains, 2,600 ft. of storm sewers, steel water tower, pipes, specials, valves, fire hydrants, fire pump, gasoline engines, etc., will be wanted. A. Whyte, mayor.

The construction of waterworks systems is contemplated at the following places: Galesburg, Mich.; Northport, Mich.; Red Hill, Pa.; Hindman, Ky.; Whitesburg, Ky.; Brunner, Tex.; Fort Francis, Ont.; Lake Village, Ark.; Montezuma, Ia.; Dows, Ia.; Clinton, Mo.; Benton, Ark.; Norway, S. C.; Presho, S. D.; Moberly, Mo.

Avon, N. Y.—Voted to issue bonds for waterworks.

Springfield, Ill.—The construction of a dam and installing a filtration plant is being urged.

Fort Erie, N. Y.—A committee has been appointed to ask for bids for a private system of waterworks. Coun.

CONTRACTS TO BE LET.

Jonesville, La.—Bids are asked until Jan. 2 for sinking an artesian well. T. M. Mathews, mayor.

Opelousas, La.—Bids are asked until Nov. 6 for boring an artesian well at the power house. B. A. Littell, mayor.

Brockton, Mass.—Bids are asked until Nov. 21 for furnishing and erecting a pumping engine. Thos. G. Nye, chmn. water comrs.

Fort Wingate, N. M.—Bids are asked until Nov. 15 for constructing a reservoir and connections here. George L. Morrison, constr. Q. M.

Philadelphia, Pa.—Sealed bids are asked until Nov. 7 for constructing preliminary filters at Belmont Station. Thos. L. Hicks, dir. pub. wks.

Washington, D. C.—Sealed bids are asked until Nov. 10 for furnishing curb and corporation cocks. H. B. F. MacFarland, chmn. Dist. comrs.

Chicago, Ill.—Sealed bids are asked until Nov. 5 for furnishing 101 tons of special castings for c. i. water pipe. Wm. L. O'Connell, cmr. pub. wks.

Philadelphia, Pa.—Bids are asked until Nov. 14 for filtering materials for the Queen Lane contingent of Torresdale filters. John R. Hathaway, dir. pub. wks.

Yonkers, N. Y.—Sealed bids are asked until Nov. 8 for furnishing and erecting a 6-mil. gal. pump at the Tube Well pumping station. John J. Devitt, prest. water comrs.

Holyoke, Mass.—Bids are asked until Nov. 12 for furnishing 139 tons of 16-in., 32 tons 12-in. c. i. water pipe, and 20,000 lbs. of special castings. Hugh McLean, chmn. water comrs.

New York City—Bids are asked until Nov. 7 for constructing and remodeling Ridgeway pumping station, Atlantic ave. between Logan and Chestnut sts., Brooklyn. John H. O'Brien, comr. water supply, etc.

Chicago, Ill.—Bids are asked until Nov. 3 for constructing a 14-ft. water tunnel, 12,180 ft. long, including certain shafts, a permanent intake crib and a temporary crib. Wm. L. O'Connell, comr. pub. wks.

Portland, Ore.—Bids are asked until Nov. 15 for constructing a dam at the outlet of Bumping Lake, Wash., involving 182,000 cu. yds. of excavation, 960 cu. yds. concrete masonry, 980 cu. yds. riprap and rockfill and 72 M. lumber. Thos. Ryan, acting secy. U. S. Reclamation Service.

Lander, Wyo.—Bids are asked until Nov. 6 for constructing waterworks and sewerage systems. Town coun.

Preston, Ont.—Bids are asked until Nov. 5 for supplying pumping machinery for the waterworks. C. R. Hanning, town clk.

Fargo, N. D.—Bids are asked until Nov. 5 for constructing water mains in 11th, 1st and Northern Pacific aves. N. C. Morgan, cy. audt.

New York City—Bids are asked until Nov. 7 for laying water mains in various streets in Boros of Manhattan, Bronx and Richmond and for furnishing hydrants. John H. O'Brien, comr. water sup.

CONTRACTS AWARDED.

North Yakima, Wash.—Jesse Rose was granted a 50-year franchise for an artesian water system.

Culver, Ind.—A waterworks system will be constructed here by the National Construction Co. of Fort Wayne, for $8,000.

New Orleans, La.—The contract for constructing 2 water purification stations was awarded to Black & Laird, for $1,840,727.30.

Holland Patent, N. Y.—The contract for constructing a waterworks system was awarded to John Siegrist, of Utica, for $13,022.70.

Jacksonville, Fla.—The contract for furnishing an 8-mil. gal. pumping engine was awarded to the Fred M. Prescott Steam Pump. Co., of Milwaukee, for $14,-190.

Hagerstown, Md.—The contract for building a 10-mil. gal. reservoir on Evers' Hill was awarded to the Whitmer Constr. Co. of Philadelphia, for $300,000.

Edinburg, Va.—The contract for constructing a waterworks system was awarded to T. A. Malone, for $6,573.25. The contract for furnishing pipes, valves, etc., was warded to the Glamorgan Pipe Co., of Lynchburg, for about $10,000.

Perry, Ok.—The contract for constructing a waterworks dam was awarded Oct. 19 to J. F. Brooks, of Red Rock, for $9,800.

Hobart, Ok.—The contract for constructing a waterworks system was awarded to J. W. Jaeger, of Rich Hill, Mo., for $23,370.

Brookhaven, Miss.—The contract for installing a new outfit of machinery in the waterworks and light plant was awarded to the New Orleans Engineering Co., of New Orleans.

BRIDGES.

Carrollton, Mo.—Bids are asked until Nov. 4 for building 4 steel bridges. Bd. co. comrs.

Peoria, Ill.—Bids are asked until Nov. 6 for building a rolling lift bridge. Comr. pub. wks.

Wichita, Kas.—Bids are asked until Nov. 5 for building steel bridges. R. N. Dorr, cy. clk.

Mt. Vernon, Ind.—Bids are asked until Nov. 5 for constructing a steel bridge in Bethel twp. Co. comrs.

Powers Ferry, Ga.—Bids are asked until Nov. 8 for constructing 2 bridges. Clk. road comrs., Atlanta.

Sheboygan, Mich.—This city contemplates asking for bids for constructing 2 concrete bridges. Cy. clk.

Hutchinson, Kas.—Council has passed a resolution to build a viaduct across the Santa Fe tracks at Adams st.

Portland, Ind.—Bids are asked until No. 5 for the removal and reconstruction a bridge in Jackson twp. Co. comrs.

Vicksburg, Miss.—Bids are asked until Nov. 5 for building a bridge over Bear Creek. J. D. Laughlin, clk. bd. supvrs.

Portland, Ind.—Bids are asked until Nov. 5 for the removal and reconstruction of a bridge. L. H. Trehearne, chmn. co. comrs.

Toronto, Ont.—Bids are asked until Nov. 6 for constructing the Lansdowne ave. subway substructure. E. Coatsworth, mayor.

Santa Barbara, Cal.—Bids are asked until Nov. 5 for repairing a bridge across Santa Ynez river. C. A. Hunt, clk. bd. supvrs.

Ripley, Ind.—Bids are asked until Nov. 3 for constructing a bridge over Graham creek, west of New Marion. Nicholas Volz, co. audt.

Gilroy, Cal.—Bids are asked until Nov. 29 for constructing a concrete bridge over Coradero creek here. J. G. McMillan, co. surv., San Jose.

Stockton, Cal.—Bids are asked until Nov. 7 for constructing a wooden trestle bridge on Locust st. extension. Eugene D. Graham, clk. bd. supvrs.

Denison, Ia.—Bids are asked until Nov. 14 for constructing and repairing wood and iron bridges in this county. Edw. Theobald, co. audt.

St. Clairsville, O.—Sealed bids are asked until Nov. 5 for erecting concrete arch bridges and bridge sub and superstructures. A. W. Beatty, co. audt.

San Jose, Cal.—Bids are asked until Nov. 5 for constructing a reinforced concrete bridge over San Francisquito creek. Henry A. Pfister, clk. bd. supvrs.

Winnipeg, Man.—Bids are asked until Nov. 20 for building a steel superstructure, with concrete abutments and piers, for a highway bridge over Red river at Redwood ave. H. N. Ruttan, cy. engr.

Atlantic City, N. J.—Sealed bids are asked until Nov. 7 for constructing a county highway bridge on the Hammonton and Atsion roads. Frank Endehlin, chmn. bridge com.

Nashville, Tenn.—Will vote in November on the issue of $800,000 bonds for constructing 2 modern steel bridges across Cumberland river here. W. M. Pollard, county judge.

Porterville, Cal.—Special.—Bids for constructing a concrete retaining wall, wing and abutment walls and piers in this city will be received until Nov. 5. M. L. Weaver, cy. engr., P. O. address, Visalia, Cal.

Atlanta, Ga.—Bids are asked until Nov. 8 (extension of time), for constructing a steel bridge on tubular piers and concrete abutments, across Chattahoochie river, betwen Cobb and Fulton counties. H. L. Culberson, chmn. co. comrs.

Reading, Pa.—Bids are asked until Nov. 2 for constructing a concrete bridge arch in Hereford twp., Berks co. H. F. Livingood, co. compt.

Celina, O.—Bids are asked until Nov. 3 for constructing sub and superstructures for a steel or concrete bridge over Wabash river, in Granville twp. T. A. Weis, co. audt.

STREET LIGHTING.

Social Circle, Ga.—The citizens voted to issue $16,000 bonds for constructing an electric light plant.

Beatrice, Neb.—A franchise has been granted to Dr. Eaton, of Cleveland, O., to furnish this city with gas at $1.19 per thousand feet.

Topeka, Kas.—Will vote Nov. 6 on the question of issuing $75,000 bonds for a municipal electric light plant of 500 lights capacity.

Ft. Wayne, Ind.—City council has passed an ordinance to vote, Nov. 6, on the question of building a municipal electric light plant.

Columbus, O.—City council has authorized the issue of $140,000 bonds for the purchase of additional machinery for the city light plant.

Big Rapids, Mich.—A contract has been awarded to the Grand Rapids-Muskegon Water, Power & Electric Co. for lighting the streets of this city.

Wellington, Kas.—Special.—O. T. Reece, cy. engr., says this city voted to issue $30,000 bonds for improvements to the municipal water and light system.

Lynchburg, Va.—Bids are asked until Nov. 10 for apparatus, machinery and supplies to form a complete arc lighting plant. Leon Goodman, chmn. com. on elect.

Eagle River, Wis.—This city has awarded a contract to Langstadt & Meyer Const. Co., of Appleton, for a municipal lighting and power plant on the Wisconsin river, 4 miles from here.

Fulton, Mo.—A municipal electric light and waterworks plant is contemplated. Jacob Wenger, cy. engr.

Mobile, Ala.—Bids are asked until Nov. 12 for constructing a municipal electric light plant. Patrick J. Lyons, mayor.

Pennsburg, Pa.—Will vote in November on the issue of $10,000 for a municipal electric lighting plant. D. K. Graber, burgess.

Lynchburg, Va.—Bids are asked until Nov. 10 for installing a complete arc lighting plant. Leon Goodman, chmn. com. on lighting.

PARKS.

Marion, O.—B. P. Wagner, of Sidney, O., has been engaged to plan a complete system of parks.

Savannah, Ga.—This city has purchased the fairgrounds tract just outside of the city, and will convert it into a public park.

Cincinnati, O.—The park commission has engaged George E. Kessler, of Kansas City, Mo., to plan a comprehensive park system for this city.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Moline, Ill.—City council will ask for bids for a garbage incinerator.

Huntington, W. Va.—The construction of a garbage incinerator plant is contemplated.

Oakland, Cal.—Mayor Frank Mott is urging the question of securing a garbage disposal plant.

Rome, N. Y.—The contract for collecting garbage for 3 years was awarded, Oct. 15, to John Zimmerman for $3,200.

Birmingham, Ala.—A resolution has been introduced providing for the immediate erection of a garbage crematory.

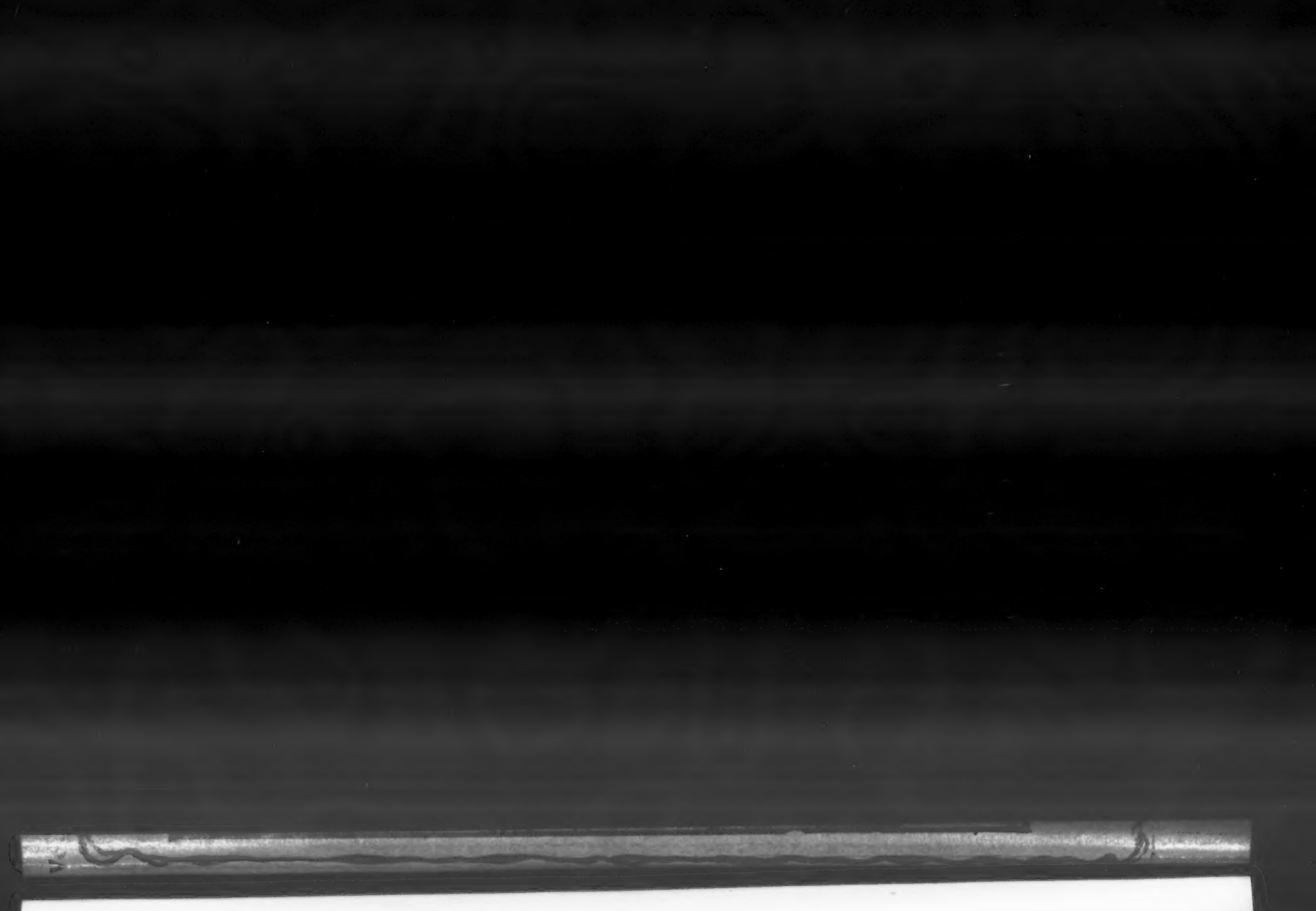
Ft. Wayne, Ind.—The contract for disposing of the city garbage for a year was awarded to Frank Draker, Oct. 9, for $4,675.

Rochester, N. Y.—Bids are asked until Nov. 7 the collection and disposal of garbage and dead animals for 5 years. F. X. Pifer, cy. clk.

Fort Des Moines, Ia.—Bids are asked until Nov. 14 for constructing 1 crematory building and garbage crematory, at Fort Des Moines. W. E. Cole, Q. M.

Philadelphia, Pa. — Special. — Adolf Kreutzer, 4146 Lancaster ave., desires the names of the presidents of the different incinerating companies, and also the builders of these plants.

FIRE APPARATUS.

Grand Forks, N. D.—Bids are asked until Nov. 5 for 1,000 ft. of 2 1-2-in. fire hose. W. V. O'Connor, cy. audt.

Winnipeg, Man.—This city is in the market for 7,500 ft. of 3 1-2-in. fire hose, and a fire alarm system. J. C. Latimer, alderman.